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DIVISION OF PUBLICATIONS.

FARMERS' BULLETINS

Nos. 651–675,

WITH CONTENTS AND INDEX.

PREPARED UNDER THE SUPERVISION OF

JOS. A. ARNOLD,

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

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Contribution from the Bureau of Crop Estimates, Leon M. Estabrook, Chief.
February 6, 1915.

THE AGRICULTURAL OUTLOOK.

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TIME OF ISSUANCE AND SCOPE OF MARCH CROP REPORT.

On Monday, March 8, at 2.15 p. m., the Bureau of Crop Estimates, Department of Agriculture, will issue a report relating, mainly, to stocks of grain in farmers' hands. The report will give an estimate of the amount of wheat, corn, oats, and barley of the 1914 crop on farms in the United States on March 1; the proportion of each of these crops which will be shipped out of counties where grown, and the percentage of the 1914 corn crop which was of merchantable quality. Detailed estimates, by States, will be published in the March issue of the Agricultural Outlook.

LIVE STOCK ON FARMS, JANUARY 1, 1915.

In this issue of the Agricultural Outlook are given estimates of the numbers and values of live stock on farms and ranges, by States as well as for the United States, on January 1, 1915. Similar estimates for previous years are also given for the purpose of comparison.

The numbers of every class of live stock—that is, horses, mules, milch cows, other cattle, sheep, and swine—increased during the past year. Such general increase has not occurred in any of the previous five years. The increase in numbers of horses amounted to 233,000, or 1.1 per cent; of mules to 30,000, or 0.7 per cent; of milch cows to 525,000, or 2.5 per cent; of other cattle to 1,212,000, or 3.4 per cent; of sheep to 237,000, or 0.5 per cent; of swine to 5,685,000, or 9.6 per cent.

The total value of all live stock on farms and ranges January 1 is estimated at $5,969,253,000, an increase of $78,024,000, or 1.3 per cent, over the valuation a year ago. Of this total valuation nearly

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one-half is for work animals, and the other half for food animals. During the past year the prices as well as the total value of work animals decreased, but the prices as well as the total value of food animals increased. Swine alone of the food animals decreased somewhat in price per head, although their aggregate value is higher than a year ago.

The value of horses per head has been tending downward moderately for the past two years; the decline during the past year, however, has been more material. The loss is severest in the cotton-growing States and in the surplus breeding States. Undoubtedly the depression in the cotton situation is responsible to a great extent for this decline in value and much more than offsets any tendency toward increased prices from foreign demand for horses for war purposes. Mules, which are used in the South more extensively than horses, declined in value more than did horses.

Milch cows have increased more during the past year than usual; that is, 2.5 per cent, which is somewhat greater than the rate of increase of population in the United States; but, notwithstanding this increase, their values have continued to increase. At the present time an average cow is worth more than $55, whereas five years ago the average cow was worth only about $35.

One of the most significant features of the live-stock situation at the present time is the turn from a long, steady decline in numbers of beef cattle to an increase, the increase for the year being 3.4 per cent. In the live-stock markets relatively smaller marketings of calves and cows in the past year indicate the disposition to increase supplies. Notwithstanding the increased numbers, the value per head was about 7 per cent higher than a year ago.

Sheep declined in numbers during the year in the eastern farming States, but increased on the ranges. The spring of 1914 was favorable for saving the lamb crop; wool has been fairly remunerative in price of late; feed supply on the ranges is fairly liberal; and, consequently, there is an effort toward renewing, or increasing, sheep raising on the ranges. In Montana and Wyoming the opening of new settlements is decreasing the range area, but not to an extent sufficient to offset the tendency to increase in other sections of the range country.

Swine increased to a greater extent than any other class of stock during the past year. This is due partly to diminished effect of the ravages of hog cholera, and partly to a favorable year for breeding stock. In consequence of the large increase in numbers, the value per head has declined moderately, but prices are still relatively high, and the total value of all swine in the country was higher on January 1 than in any previous year on that date.

Tables 7 to 12, giving the details, will be found on pages 14 to 19.

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LIVE-STOCK VALUES PER HEAD.

TABLE 1.— *Years of lowest and highest United States averages since 1866, and values Jan. 1, 1915.*

Class of animals.	Lowest.		Highest.		Increase, per cent.	Value per head, Jan. 1, 1915.
	Value per head.	Year.	Value per head.	Year.		
Horses	$31.51	1897	$111.46	1911	254	$103.33
Mules	41.66	1897	125.92	1911	202	112.36
Milch cows	21.40	1892	55.33	1915	159	55.33
Other cattle	14.06	1895	33.38	1915	137	33.38
Sheep	1.58	1895	4.50	1915	185	4.50
Swine	3.18	1879	10.40	1914	227	9.87

YEARLY MARKETINGS OF LIVE STOCK.

The combined receipts of hogs, cattle, and sheep at Chicago, Kansas City, Omaha, St. Louis, Sioux City, St. Joseph, and St. Paul yearly since 1900 were as follows:

TABLE 2.

Year.[1]	Cattle.[2]	Hogs.	Sheep.	Year.	Cattle.	Hogs.	Sheep.
1900	7,179,344	18,573,177	7,061,466	1908	8,827,360	22,863,701	9,833,640
1901	7,708,839	20,339,864	7,798,359	1909	9,189,312	18,834,641	10,284,905
1902	8,375,408	17,289,427	9,177,050	1910	9,116,687	14,853,472	12,366,375
1903	8,878,789	16,780,250	9,680,692	1911	8,629,109	19,926,547	13,521,492
1904	8,690,699	17,778,827	9,604,812	1912	8,061,494	19,771,825	13,733,980
1905	9,202,083	18,988,933	10,572,259	1913	7,904,552	19,924,331	14,037,830
1906	9,373,825	19,223,792	10,864,437	1914	7,182,239	18,272,091	13,272,491
1907	9,500,710	19,544,617	9,857,877				

[1] Figures for 1900–1909, inclusive, were taken from the Monthly Summary of Commerce and Finance of the United States; 1910, and subsequently, from official reports of the stock yards in the cities mentioned.
[2] The receipts of calves (not included in "cattle") at the stock yards of Chicago, Kansas City, St. Joseph, St. Paul, and Sioux City, combined, were about 664,000 in 1914, as compared with about 741,000 in 1913, about 910,000 in 1912, 975,000 in 1911, 981,000 in 1910, and 869,000 in 1909.

EFFECT OF WAR ON EXPORTS OF HORSES.

By G. A. BELL, *Senior Animal Husbandman, Bureau of Animal Industry.*

During the four months September to December, 1914, inclusive, about 75,000 horses were exported from the United States. In addition to these several thousand more have been purchased for export by the agents of the warring nations. It has been feared by some that there would be such large numbers exported as to cause an acute shortage of horses in this country. There is, however, no apparent immediate danger of this.

The 1910 census gave 3,182,789 as the number of horses not on farms. There has probably not been any appreciable decrease in that number since then. That number added to the 21,195,000, the number estimated by the Department of Agriculture, on farms January 1, 1915, makes a total of over 24,000,000 horses in this country, and we could sell two or three times the number already exported without there being an appreciable shortage of work horses. Three times

the number exported during the last four months of the past year, or 225,000, would be less than 1 per cent of our horse stock. Furthermore, the kind of horses which have been purchased are for the most part very mediocre animals, which would ordinarily sell for less than $100 per head and are a class of which we can well afford to be rid. But a small percentage of the animals exported are mares and most of these are doubtlessly either old mares or nonbreeders.

The big demand for horses will probably occur after peace has been declared. At that time the countries now at war, with the exception of Russia, will no doubt be very short of horses for their agricultural and other work. According to the best information obtainable European Russia had, prior to the outbreak of the war, about 25,000,000 horses, and is the only country having more horses than the United States. This country and Russia together have 50 per cent of all the horses in the world. The world's stock is estimated to be about 100,000,000. A very large number of the horses in Russia will be destroyed in the war and the remainder will no doubt be needed by Russia for her own agricultural and other work.

The demands on this country, which has one-fourth of the world's supply of horses, will, therefore, be large and will probably continue for a number of years, for the rehabilitation of the depleted horse stock of any country is a slow process. This country, however, will be in position to meet this demand if the farmers owning good mares will see that they are bred. The owners of such mares should see that they are bred to high-class stallions and produce the kind of stock for which there is always a good market. The production of superior animals of any kind is generally profitable, while the production of inferior ones is seldom so.

FOOT-AND-MOUTH DISEASE AND THE NUMBER OF LIVE STOCK.

Contributed by the Bureau of Animal Industry.

The most extensive outbreak of foot-and-mouth disease ever known in the United States now seems to be under control, as a result of the vigorous policy of eradication followed. While the loss is considerable, it so far amounts to but a very small proportion of the aggregate value of the live-stock industry of the country.

Twenty States and the District of Columbia have been more or less affected since the definite discovery of the disease last October in the vicinity of Niles, Mich. These States are Connecticut, Delaware, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Montana, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Virginia, Washington, and Wisconsin.

A campaign to check the spread of the disease and to stamp it out was immediately begun by the United States Department of Agri-

culture in cooperation with the State authorities. Quarantines against the movement of animals and certain materials from the infected areas were declared, shipments were traced, rumors investigated, and thorough inspections made in an effort to discover all infected stock. As measures of eradication, diseased herds are being slaughtered and buried and the premises disinfected.

By January 31 the work of eradication was practically completed in all but seven of the infected States, and further progress is continually being made, notwithstanding the occurrence of occasional new cases. There have been slaughtered 2,046 herds, consisting of 46,268 cattle, 7,151 sheep, 22 goats, and 47,735 swine, of an aggregate estimated value of $3,399,110.26.

Illinois has had the largest infected area, 50 out of a total of 102 counties being affected. In this State 484 herds have been slaughtered, comprising 14,653 cattle, 378 sheep and goats, and 21,587 swine, of a total appraised value of $1,146,985. Pennsylvania has had infection in 24 out of 67 counties, and 654 herds, valued at $721,619.30, have been slaughtered. In Michigan 236 herds and in Ohio 169 herds have been slaughtered. None of the remaining States have had over 50 herds affected, and Virginia and Washington have had only one herd each.

The total number of cattle in the United States on January 1, 1915, is estimated at 58,329,000. The number of cattle slaughtered in stamping out foot-and-mouth disease is therefore less than eight one-hundredths of 1 per cent of the total number, and if there is no further extension of the infection the number of known affected herds remaining to be slaughtered will probably not raise the total loss beyond one-tenth of 1 per cent. The number of animals slaughtered does not exceed the number killed in two or three days in some of the larger packing-house centers. So far the losses are mainly local and have had no appreciable general effect on the country's total supply of meat and dairy animals. The owners of live stock and other property destroyed on account of the disease are reimbursed to the extent of the appraised value, half of which is paid by the Federal Government and half by the State.

If the plague had been temporized with and had gotten beyond control, the United States would doubtless have had to endure permanently an annual loss of many millions of dollars.

STOCKS OF POTATOES JANUARY 1, 1915.

Unusually large stocks of potatoes were held on January 1 in the large potato-producing States, according to reports of correspondents of the Bureau of Crop Estimates. Southern potato growers who

compete in the spring months with the stocks carried over in the northern States should recognize this fact—that supplies of northern potatoes are larger than in any of the past five years. Prices are unusually low, and therefore may not decline further, but material advances in the next few months can not be forecast from present supplies.

The estimates indicate that 52.8 per cent of the marketable supply of potatoes of the 1914 crop remained in the hands of producers or dealers on January 1 in the States included in the investigation, which compares with 51.6 per cent of the 1913 crop held on January 1, 1914, 49.6 per cent similarly held two years ago, 41.7 three years ago, and 51.1 four and five years ago.

If, for the purpose of comparison, these percentages be applied to the estimates of total production, it shows, in the States included (which produced 78 per cent of the United States crop), a total of 166,846,000 bushels January 1, 1915, compared with 123,292,000 a year ago, 149,845,000 two years ago, 90,778,000 three years ago, 133,411,000 four years ago, and 142,381,000 bushels five years ago.

One feature of the situation is that stocks are held by growers more largely than usual; this year their holdings on January 1 were nearly 5.6 times the amount held by dealers, whereas in the past five years their holdings have averaged 4.0 times the amount held by dealers.

The United States seldom imports or exports relatively a large quantity of potatoes. Therefore the European war has no material direct bearing upon the potato market of the United States.

Detailed estimates by States are given in Table 3.

TABLE 3.—*Stocks of potatoes, Jan. 1, 1915.*

State and year.	Total production, bushels (000 omitted).	Stock in growers' hands, Jan. 1.		Stock in dealers' hands, Jan. 1.		Total stock, bushels (000 omitted).	Price per bushel—	
		Per cent of crop.	Bushels (000 omitted).	Per cent of crop.	Bushels (000 omitted).		Dec. 1.	Mar. 1.
New England:							*Cents.*	*Cents.*
1914-15	49,073	51	25,027	9	4,417	29,444	42	.....
1913-14	39,102	46	17,874	11	4,388	22,262	61	6
1912-13	35,592	48	17,084	7	2,491	19,575	59	54
1911-12	30,925	48	14,844	6	1,856	16,700	82	112
New York:								
1914-15	53,215	55	29,268	3	1,596	30,864	44	.....
1913-14	26,640	55	14,630	4	1,064	15,694	80	78
1912-13	38,160	47	17,935	4	1,526	19,461	58	63
1911-12	27,750	35	9,712	5	1,388	11,100	90	109
Pennsylvania:								
1914-15	28,140	41	11,537	7	1,970	13,507	58	.....
1913-14	23,320	38	8,854	11	2,563	11,417	80	81
1912-13	28,885	33	9,532	8	2,311	11,843	57	62
1911-12	15,120	23	3,478	5	756	4,234	93	115
New Jersey:								
1914-15	9,936	8	795	4	397	1,192	61	.....
1913-14	8,930	6	534	2	178	712	82	88
1912-13	9,936	13	1,292	3	298	1,590	66	71
1911-12	6,132	6	368	4	245	613	105	114

TABLE 3.—*Stocks of potatoes, Jan. 1, 1915*—Continued.

State and year.	Total production, bushels (000 omitted).	Stock in growers' hands, Jan. 1.		Stock in dealers' hands, Jan. 1.		Total stock, bushels (000 omitted).	Price per bushel—	
		Per cent of crop.	Bushels (000 omitted).	Per cent of crop.	Bushels (000 omitted).		Dec. 1.	Mar. 1.
Ohio:							*Cents.*	*Cents.*
1914-15	14,250	34	4,845	9	1,282	6,127	53	.....
1913-14	10,240	26	2,652	10	1,020	3,672	85	83
1912-13	20,832	31	6,459	12	2,500	8,959	53	58
1911-12	12,350	25	3,088	7	864	3,952	84	114
Indiana:								
1914-15	6,000	33	1,980	12	720	2,700	56	.....
1913-14	3,975	30	1,200	16	640	1,840	84	84
1912-13	9,918	31	3,075	16	1,587	4,662	50	54
1911-12	5,162	22	1,136	10	516	1,652	87	116
Illinois:								
1914-15	7,440	28	2,083	15	1,116	3,199	61	.....
1913-14	5,750	21	1,218	5	290	1,508	89	87
1912-13	13,837	17	2,352	11	1,522	3,874	60	62
1911-12	6,900	20	1,380	10	1,035	2,415	90	113
Michigan:								
1914-15	44,044	52	22,903	8	3,524	26,427	30	.....
1913-14	33,600	49	16,964	12	4,032	20,996	55	53
1912-13	36,750	51	18,742	11	4,042	22,784	41	38
1911-12	31,020	41	12,718	10	3,102	15,820	71	89
Wisconsin:								
1914-15	37,696	54	20,356	10	3,770	24,126	30	.....
1913-14	32,155	53	17,066	10	3,220	20,286	54	55
1912-13	34,920	51	14,809	11	3,841	18,650	34	32
1911-12	32,480	37	12,018	11	3,573	15,591	62	85
Minnesota:								
1914-15	30,780	36	11,081	9	2,770	13,851	32	.....
1913-14	30,250	37	11,174	13	3,926	15,100	52	55
1912-13	33,075	41	13,561	15	5,161	18,722	28	28
1911-12	25,875	32	8,280	12	3,105	11,385	58	84
Iowa:								
1914-15	12,642	23	2,908	19	2,402	5,310	59	.....
1913-14	7,200	20	1,440	2	144	4,320	82	93
1912-13	18,966	31	5,879	15	2,845	8,724	46	50
1911-12	12,876	15	1,931	10	1,288	3,219	73	110
Nebraska:								
1914-15	9,440	38	3,587	9	850	4,437	54	.....
1913-14	5,664	27	1,539	8	456	2,095	78	84
1912-13	9,440	32	3,021	8	755	3,776	51	52
1911-12	6,032	25	1,508	10	603	2,111	92	124
Kansas:								
1914-15	4,464	10	446	5	223	669	77	.....
1913-14	2,920	10	290	8	232	522	91	98
1912-13	5,740	19	1,091	14	804	1,895	73	76
1911-12	1,760	11	194	7	123	317	106	132
Colorado:								
1914-15	8,760	50	4,380	7	613	4,993	50	.....
1913-14	9,200	55	5,060	7	644	5,704	65	60
1912-13	8,075	60	4,845	6	484	5,329	41	43
1911-12	3,150	45	1,418	8	252	1,670	99	100
Total above:								
1914-15	315,880	44.7	141,196	8.1	25,650	166,846	43.2	.....
1913-14	238,946	42.1	100,495	9.5	22,797	123,292	66.2	67.0
1912-13	304,126	39.8	119,678	9.8	30,167	149,845	48.6	47.7
1911-12	217,532	33.1	72,072	8.6	18,706	90,778	77.6	101.4
1910-11	261,141	40.2	104,954	10.9	28,457	133,411	49.5	46.9
1909-10	298,308	41.2	122,997	9.9	29,384	142,381	50.0	47.3

FALL SEEDINGS IN COTTON STATES.

The amount of oats sown in the cotton States the past fall was 102 per cent larger than the amount sown in the fall of 1913, according to estimates of crop correspondents made within the past month. The oats acreage in the cotton States in 1914 was estimated at 4,355,000 acres, of which 43 per cent was planted in autumn and 57 per cent in spring. These figures would indicate that in the cotton States about

1,900,000 acres more were sown to oats last fall than in the fall of 1913.

In December the Department of Agriculture estimated the acreage sown last fall to wheat in the cotton-growing States as 7,271,000 acres, as compared with 5,459,000 the preceding year—an increase of 33 per cent, or 1,812,000 acres.

The estimated increases of fall seedings, by States, are shown in Table 4.

TABLE 4.—*Increased fall seedings in cotton States.*

State.	Fall-sown wheat.		Fall-sown oats.		Cotton, acres, 1914, preliminary.	Per cent of fall-sown to cotton acreage.
	Increase, per cent.	Increase, acres.	Increase, per cent.	Increase, acres.		
North Carolina	75	470,000	56	98,000	1,600,000	36
South Carolina	200	164,000	112	336,000	2,800,000	18
Georgia	118	170,000	96	328,000	5,375,000	9
Florida	.....	.....	64	20,000	195,000	10
Alabama	185	63,000	116	258,000	3,875,000	8
Mississippi	125	1,000	147	156,000	3,120,000	5
Louisiana	.....	.....	189	94,000	1,360,000	7
Texas	20	228,000	66	291,000	11,930,000	4
Arkansas	44	56,000	211	154,000	2,525,000	8
Tennessee	20	145,000	127	124,000	890,000	30
Oklahoma	20	515,000	133	44,000	2,825,000	20
Total above	33	1,812,000	102	1,903,000	36,722,000	10

The increase in the acreage sown to fall wheat and oats in the cotton States appears to have been about 3,700,000 acres, or over 10 per cent of the acreage planted to cotton last year. Reports received indicate an intention to increase considerably the acreage of spring planting of corn and spring-sown oats.

CROP-VALUE COMPARISONS.

The estimated total value of 13 crops—corn, wheat, oats, barley, rye, buckwheat, flaxseed, rice, potatoes, sweet potatoes, hay, tobacco, and lint cotton—in the United States, by States, in order of their rank in 1914, is given in Table 5. Values used are farm values on December 1 as estimated by the Department of Agriculture, except for cotton in the years 1909–1911; in those years values given by the Bureau of the Census for lint ginned from the respective crops of those years were used.

TABLE 5.—*Estimated value in 1914 of 13 crops considered by the United States Department of Agriculture, with comparisons.*

State.	Value of crops named in text (000 omitted).				Value of all crops, 1909, census (000 omitted).	Value of crops named in text, 1909, compared with value of all crops.	Rank of State.			Value of crops named in text, 1914—		
	1914.	1913.	1909 (census).	Five-year average, 1909–13.			Crops named in text.		All crops, 1909.	Compared with 1913.	Compared with 5-year average.	Compared with 1909.
							1914.	1909.				
						P. ct.				P. ct.	P. ct.	P. ct.
Iowa	$351,450	$327,996	$287,065	$284,280	$314,666	91	1	2	2	+ 7.2	+23.6	+ 22.4
Illinois	319,656	295,046	342,861	307,593	372,270	92	2	1	1	+ 8.3	+ 3.9	— 6.8
Texas	288,335	400,231	244,721	336,725	298,133	82	3	3	3	— 28.0	—14.4	+ 17.8
Kansas	287,662	124,136	189,091	164,844	214,860	88	4	5	7	+131.7	+74.5	+ 52.1
Nebraska	210,099	162,078	173,512	153,869	196,126	88	5	9	10	+ 29.6	+36.5	+ 21.1
Ohio	207,337	212,434	197,288	202,084	230,338	86	6	4	4	— 2.4	+ 2.6	+ 5.1
Missouri	192,981	174,520	188,524	188,689	220,664	85	7	6	6	+ 10.6	+ 2.3	+ 2.4
Indiana	189,553	185,917	181,234	172,499	204,210	89	8	7	9	+ 2.0	+ 9.9	+ 4.6
Minnesota	180,432	194,178	168,706	174,074	193,451	87	9	10	11	— 7.1	+ 3.7	+ 7.0
Pennsylvania	173,967	168,998	130,010	160,346	166,740	78	10	13	13	+ 2.9	+ 8.5	+ 33.8
New York	161,919	148,767	132,620	149,913	209,168	63	11	12	8	+ 8.8	+ 8.0	+ 22.1
Georgia	155,167	217,753	176,959	188,709	226,595	78	12	8	5	— 28.7	—17.8	— 12.3
Wisconsin	152,321	155,465	121,048	139,157	148,359	82	13	14	16	— 2.0	+ 9.5	+ 25.8
North Dakota	144,293	105,356	168,292	123,448	180,636	93	14	11	12	+ 37.0	+16.9	— 14.3
Michigan	139,899	122,555	114,808	125,501	162,005	71	15	15	14	+ 14.2	+11.5	+ 21.9
Oklahoma	134,159	111,532	112,344	117,618	133,454	84	16	17	22	+ 20.3	+14.1	+ 19.4
N. Carolina	124,918	150,203	102,783	126,456	142,890	72	17	22	19	— 16.8	— 1.2	+ 21.5
Kentucky	118,325	110,654	114,202	114,784	138,973	82	18	16	21	+ 6.9	+ 3.1	+ 3.6
Alabama	114,255	156,175	108,095	132,952	144,287	75	19	20	18	— 26.8	—14.1	+ 5.7
South Dakota	106,488	94,397	109,353	91,894	125,507	87	20	19	23	+ 12.8	+15.9	— 2.6
Tennessee	106,456	114,249	93,341	108,188	120,706	77	21	23	24	— 6.8	— 1.6	+ 14.1
S. Carolina	101,373	139,076	109,699	121,920	141,983	77	22	18	20	— 27.1	—16.9	— 7.6
Mississippi	93,882	130,622	107,054	117,385	147,316	73	23	21	17	— 28.1	—20.0	— 12.3
California	91,261	88,837	71,994	91,729	153,111	47	24	25	15	+ 2.7	— 0.5	+ 26.8
Arkansas	81,883	103,132	86,611	96,881	119,419	73	25	24	25	— 20.6	—15.5	— 5.5
Washington	75,653	73,246	64,340	69,465	78,927	82	26	27	27	+ 3.3	+ 8.9	+ 17.6
Virginia	73,995	100,807	71,153	81,924	100,531	71	27	26	26	— 26.6	— 9.7	+ 4.0
Louisiana	64,767	73,335	47,577	60,247	77,336	62	28	28	28	— 11.7	+ 7.5	+ 36.1
Montana	47,893	41,214	22,394	35,264	29,715	75	29	36	38	+ 16.2	+35.8	+113.9
Colorado	46,111	43,149	31,416	37,722	50,975	62	30	31	29	+ 6.9	+22.2	+ 46.8
Oregon	44,418	40,069	33,140	39,803	49,041	68	31	29	30	+ 10.9	+11.6	+ 34.0
Maryland	42,893	35,089	31,454	34,520	43,920	72	32	30	31	+ 22.2	+24.3	+ 36.4
West Virginia	38,937	42,213	27,749	35,556	40,375	69	33	34	32	— 7.8	+ 9.5	+ 40.3
Idaho	38,191	35,294	28,816	34,513	34,358	84	34	32	36	+ 8.2	+10.7	+ 32.5
Maine	34,039	35,553	27,836	34,834	39,318	71	35	33	34	— 4.3	— 2.3	+ 22.3
New Jersey	29,441	30,337	23,396	27,813	40,341	58	36	35	33	— 3.0	+ 5.9	+ 25.8
Vermont	23,449	24,332	18,577	23,197	27,447	68	37	37	39	— 3.6	+ 1.1	+ 26.2
Massachusetts	20,839	18,432	14,916	17,524	31,948	47	38	39	37	+ 13.1	+18.9	+ 39.7
Connecticut	20,799	18,930	14,872	18,837	22,488	66	39	40	40	+ 9.9	+10.4	+ 39.9
Utah	19,743	17,698	13,682	16,262	18,485	74	40	41	41	+ 11.6	+21.4	+ 44.3
Florida	19,405	19,688	14,932	17,384	36,142	41	41	38	35	— 1.4	+11.6	+ 30.0
Wyoming	16,352	12,851	7,508	12,899	10,023	75	42	43	43	+ 27.2	+26.8	+117.8
N. Hampshire	12,920	11,201	9,233	11,216	15,976	58	43	42	42	+ 15.3	+15.2	+ 39.9
N. Mexico	10,377	9,017	5,591	8,282	8,922	63	44	45	45	+ 15.1	+25.3	+ 85.6
Nevada	9,832	9,980	4,082	8,181	5,924	69	45	46	46	— 1.5	+20.2	+140.9
Delaware	9,437	7,810	6,543	7,649	9,122	72	46	44	44	+ 20.8	+23.4	+ 44.2
Arizona	6,894	8,818	3,993	6,604	5,497	73	47	47	47	— 21.8	+ 4.4	+ 72.7
Rhode Island	2,437	2,451	2,030	2,295	3,937	52	48	48	48	— 0.6	+ 6.2	+ 20.0
U. S.	4,936,893	4,905,881	4,357,445	4,633,529	5,486,615	79.4	.....	.....	.....	+ 0.6	+ 6.5	+ 13.3

TREND OF PRICES OF FARM PRODUCTS.

The level of prices paid producers of the United States for the principal crops increased about 2.9 per cent during December; in the past six years the price level has increased during December 1.1 per cent.

On January 1 the index figure of crop prices was about 4.6 per cent lower than a year ago, 14 per cent higher than two years ago, and 1.4 per cent higher than the average of the past six years on January 1.

The level of prices paid to producers of the United States for meat animals decreased 2.7 per cent during the month from November 15 to December 15. This compares with an average decline from November 15 to December 15 in the past four years of 1.8 per cent.

On December 15 the average (weighted) price of meat animals—hogs, cattle, sheep, and chickens—was $6.61 per 100 pounds, which compares with $6.85 a year ago, $6.42 two years ago, $5.37 three years ago, and $6.21 four years ago on December 15.

A tabulation of prices is shown in Tables 13 to 21.

APPLE COLD-STORAGE HOLDINGS AND THE MARKET.

By CLARENCE W. MOOMAW,

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Although dealers generally report that the holiday demand for apples did not prove to be as expected, the result of investigations conducted by the Office of Markets would indicate that the movement of cold-storage apples during the month of December was satisfactory under the conditions. The following recapitulation may be of service to growers, dealers, and cold storages in arriving at helpful conclusions regarding the present and future of the season's cold-storage deal:

Number of apple cold storages reporting for January 1, 1915		306
Number reporting on October 15, 1914, but not reporting January 1, 1915		60
Number reporting on December 1, 1914, but not reporting January 1, 1915		75
Total capacity of firms reporting January 1, 1915	barrels..	7,093,691
Holdings January 1, 1915 (2,517,912 barrels and 2,759,128 boxes)	do....	3,437,621
Holdings January 1, 1913 (1,839,057 barrels and 2,859,535 boxes)	do....	2,792,235

Of the 306 firms reporting for January 1, 1915, only 231 reported December 1, 1914. The holdings of these 231 firms upon the two dates mentioned were as follows:

December 1 (2,232,613 barrels and 2,306,236 boxes)	barrels..	3,001,358
January 1 (1,872,627 barrels and 2,208,175 boxes)	do....	2,608,685

The total movement from these storages in December thus amounted to 392,673 barrels. If the average condition for 231 cold

storages situated in all parts of the country is a criterion, approximately 13 per cent of the total cold-storage holdings December 1 were marketed prior to January 1.

Analyzing the movement for barrels and boxes, it is noted that according to these reports the movement of barreled apples has been much greater than the movement of boxed apples. It is seen that during the month of December 359,986 barrels were marketed, whereas the movement of boxes amounted to only 98,061; or, in other words, approximately 16 per cent of barrels were moved as against 4.2 per cent of boxes.

Remembering that cold-storage apples met with heavy competition in the distribution of common-storage stock, it is apparent that the movement of barreled apples in December, as indicated by the above recapitulation, was liberal. Common-storage apples are chiefly marketed prior to January 1, and the entire common-storage holdings as a rule are out of the way by February 1. This does not mean that high prices can be expected, but rather that the fruit ought to move gradually to meet the heavy demand which has been created during the past few months as the result of bountiful supply and low prices. With common-storage apples out of the way, the demand for remaining cold-storage stock will increase proportionately.

January trade in apples may not be typical of the winter-apple market, for the reason that immediately following the holidays dealers do not take on large supplies as a rule, because consumption is curtailed as the result of Christmas purchases. However, it is reasonable to expect that the reports for February 1 will show a movement relatively as liberal as the movement of December.

The percentage of movement in December for box apples was small, but it is to be remembered that large quantities of this pack are held in common storage in the box-apple producing areas, and that box apples placed in cold storage under conditions existing this year were held largely for the later winter markets. The cold-storage holdings of apples are admittedly large, and a regular, vigorous movement throughout the remainder of the season may be necessary to prevent disaster in the spring. Growers and dealers are urged neither to dump their holdings nor to stand for arbitrarily high prices. Panicky selling usually means grief, but all concerned should seek to move cold-storage apples gradually and with such rapidity as the market allows, so that the deal may be wound up in relatively good shape.

Referring to the response of cold storages to the inquiries of the Office of Markets, it is gratifying to note that 75 additional firms reported their holdings January 1. The capacity of storages reporting December 1 was 5,465,310 barrels, whereas the capacity of those reporting for January 1 was 7,093,691 barrels. It is hoped that other

cold storages which have not replied to previous inquiries will realize the importance of these investigations to growers, dealers, and storages alike, and will cooperate with this office to the end that these reports may be of the utmost service.

PRODUCTION OF UPLAND LONG-STAPLE COTTON, 1 1/16 INCHES AND OVER.

As a result of frequent requests for information regarding long-staple cotton, the Bureau of Crop Estimates has made an inquiry to determine what percentage of the total crop is long staple, where this staple is principally produced, and the usual yields and selling prices compared with short-staple cotton.

While the bureau's inquiry restricted the term "long staple" to lint 1 3/16 inches or over in length, many correspondents reported under this head cotton of less length, but known locally as long staple. Wherever it was evident that this misunderstanding existed such reports have been disregarded, but it is probable that this oversight on the part of correspondents has resulted in showing the percentage raised of staple 1 3/16 inches and over in length and its yield per acre as somewhat higher and the price received lower than the actual facts warrant.

The reports received from the voluntary correspondents, supplemented by the investigations of the field agents of the bureau, in the cotton States indicate the approximate percentages shown in Table 6 of long staple (1 3/16 inches and over), short staple (under 1 3/16 inches), and sea island cotton produced in 1914, with the yields secured and the prices obtained for each:

TABLE 6.—*Upland long-staple, short-staple, and sea-island cotton: Relative production, yields per acre, and prices.*

State.	Proportion of entire cotton crop.			Yields per acre.			Prices.		
	Long.	Short.	Sea island.	Long.	Short.	Sea island.	Long.	Short.	Sea island.
	Per cent.	*Per cent.*	*Per cent.*	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*	*Cents.*	*Cents.*
Virginia	1.0	99.0	.....	230	255	.....	9.0	7.3	.....
North Carolina	1.4	98.6	.....	250	283	.....	10.0	6.9	.....
South Carolina	4.0	95.4	0.6	265	256	140	10.0	6.7	19.0
Georgia	2.5	95.0	2.5	210	237	185	9.5	6.6	15.8
Florida	7.0	38.0	55.0	155	220	165	13.0	7.0	15.0
Alabama	.5	99.5	.....	255	209	.....	10.0	6.7	.....
Mississippi	11.0	89.0	.....	215	194	.....	10.0	6.8	.....
Louisiana	2.0	98.0	.....	150	162	.....	9.5	6.9	.....
Texas	.3	99.7	.....	175	183	.....	10.0	6.8	.....
Oklahoma	1.0	99.0	.....	185	212	.....	7.0	6.5	.....
Arkansas	6.0	94.0	.....	185	198	.....	8.7	6.5	.....
Tennessee	.5	99.5	.....	180	196	.....	9.3	6.4	.....
Missouri	2.0	98.0	.....	325	295	.....	9.0	6.4	.....
California	25.0	75.0	.....	500	500	.....	10.2	6.0	.....

The maximum production of long staple in the rich delta lands of the lower Mississippi Valley, to which this type was, until recent years, largely confined, was between 300,000 and 400,000 bales. Since the coming of the boll weevil, to which the older varieties of long staple appear to have been particularly susceptible, the production there seems to have diminished to about half the former maximum production and in some counties to have almost entirely ceased. The entire production of the United States, as indicated by these reports, is slightly over 400,000 bales, but, as before explained, these figures probably include some of the longer varieties under $1\frac{3}{16}$ inches in length.

Some light on the production of $1\frac{1}{8}$-inch lint, considered as long-staple upland in many classifications, may be gained from the statement in Department Bulletin 121, showing the annual consumption by the United States and Canadian mills to be about 850,000 bales of this length compared with 280,000 bales of the length of $1\frac{3}{16}$ inches and over. Assuming the same proportions, this would indicate a total production of considerably over 1,000,000 bales of cotton $1\frac{1}{8}$ inches and over in length in 1914.

The principal areas of present production, additional to the delta lands extending through western and northwestern Mississippi, eastern and southeastern Arkansas, northeastern Louisiana, and into Tennessee, already mentioned, appear to be the counties on the Red River or its tributaries in southwestern Arkansas and northeastern Texas; the counties of Darlington, Chesterfield, and Marlboro in northern South Carolina, with some extension into the counties across the line in North Carolina; a group of counties along the Savannah River in Georgia and South Carolina; and small groups or isolated counties in other States.

While the yields shown in the table indicate that long staple is only slightly less productive than short staple, and in several States even larger yields are shown, a study of the individual reports indicate that the yields per acre of long-staple varieties at present generally grown are less than those of short staple, as a rule. While certain improved varieties of long staple may give a yield of lint equal to that of short varieties, the favorable showing in the table for average yields of long staple in comparison with short is partly due to the fact that the long staple is grown by the more progressive farmers on better land and with better cultivation, while the short staple is the average for all farmers.

The improved varieties of long-staple upland cotton developed in recent years by the specialists in the Bureau of Plant Industry of this department are fully equal in yield of lint to the average short-staple varieties.

ESTIMATED NUMBER ON FARMS AND VALUE OF DOMESTIC ANIMALS.

TABLE 7.—*Horses: Estimated number on farms, and value, Jan. 1, 1915, with comparisons.*

State.	Number (000 omitted).				Value per head, Jan. 1.			Total value Jan. 1 (000 omitted).		
	Jan. 1, 1915.		Jan. 1, 1914.	Apr. 15, 1910 (census).	1915	1914	1910	1915	1914	1910 [2]
	Per cent. [1]	Total.								
Maine	102	113	111	108	$146.00	$150.00	$125.00	$16,498	$16,650	$13,500
New Hampshire	100	47	47	46	127.00	137.00	106.00	5,969	6,439	4,876
Vermont	100	88	88	81	131.00	129.00	106.00	11,528	11,352	8,586
Massachusetts	99	64	65	64	155.00	161.00	128.00	9,920	10,465	8,192
Rhode Island	100	10	10	9	146.00	156.00	129.00	1,460	1,560	1,161
Connecticut	100	47	47	46	148.00	153.00	126.00	6,956	7,191	5,796
New York	100	615	615	591	142.00	145.00	125.00	87,330	89,175	73,875
New Jersey	101	92	91	89	146.00	157.00	134.00	13,432	14,287	11,926
Pennsylvania	102	596	584	550	134.00	139.00	132.00	79,864	81,176	72,600
Delaware	102	36	35	33	100.00	105.00	105.00	3,600	3,710	3,498
Maryland	101	167	165	156	113.00	119.00	108.00	18,871	19,635	16,848
Virginia	101	354	350	330	109.00	114.00	107.00	38,586	39,900	35,310
West Virginia	101	192	190	180	114.00	122.00	112.00	21,888	23,180	20,160
North Carolina	101	182	180	166	130.00	139.00	121.00	23,660	25,020	20,086
South Carolina	98	83	85	80	131.00	144.00	127.00	10,873	12,240	10,160
Georgia	98	125	128	120	119.00	131.00	125.00	14,875	16,768	15,000
Florida	103	57	55	46	121.00	122.00	109.00	6,897	6,710	5,014
Ohio	101	910	901	910	128.00	132.00	129.00	116,480	118,932	117,390
Indiana	100	854	854	814	114.00	116.00	122.00	97,356	99,064	99,308
Illinois	98	1,467	1,497	1,453	105.00	113.00	124.00	154,035	169,161	180,172
Michigan	103	673	653	610	132.00	139.00	126.00	88,836	90,767	76,860
Wisconsin	104	705	678	615	131.00	136.00	121.00	92,355	92,208	74,415
Minnesota	103	872	847	753	116.00	125.00	111.00	101,152	105,875	83,583
Iowa	101	1,600	1,584	1,492	105.00	118.00	120.00	168,000	186,912	179,040
Missouri	100	1,095	1,095	1,073	88.00	98.00	103.00	96,360	107,310	110,519
North Dakota	105	785	748	651	110.00	112.00	114.00	86,350	83,776	74,211
South Dakota	104	759	730	669	89.00	96.00	105.00	67,551	70,080	70,245
Nebraska	99	1,038	1,048	1,008	92.00	94.00	108.00	95,496	98,512	108,864
Kansas	102	1,132	1,110	1,147	93.00	93.00	107.00	105,276	103,230	122,729
Kentucky	100	443	443	443	95.00	103.00	105.00	42,085	45,629	46,515
Tennessee	102	353	346	350	100.00	116.00	112.00	35,300	40,136	39,200
Alabama	100	149	149	136	96.00	113.00	95.00	14,304	16,837	12,920
Mississippi	100	241	241	216	86.00	95.00	85.00	20,726	22,895	18,360
Louisiana	100	191	191	181	83.00	85.00	79.00	15,853	16,235	14,299
Texas	98	1,192	1,216	1,170	78.00	80.00	73.00	92,976	97,280	85,410
Oklahoma	99	758	766	743	81.00	85.00	81.00	61,398	65,110	60,183
Arkansas	101	276	273	255	76.00	93.00	82.00	20,976	25,389	20,910
Montana	105	391	372	316	86.00	102.00	80.00	33,626	37,944	25,280
Wyoming	103	176	171	156	79.00	79.00	83.00	13,904	13,509	12,948
Colorado	102	347	340	294	85.00	83.00	85.00	29,495	28,220	24,990
New Mexico	110	217	197	179	55.00	55.00	47.00	11,935	10,835	8,413
Arizona	105	118	112	100	70.00	73.00	62.00	8,260	8,176	6,200
Utah	104	146	140	116	86.00	91.00	85.00	12,556	12,740	9,860
Nevada	102	78	76	68	69.00	78.00	78.00	5,382	5,928	5,304
Idaho	104	243	234	198	92.00	96.00	102.00	22,356	22,464	20,196
Washington	102	311	305	281	96.00	106.00	108.00	29,856	32,330	30,348
Oregon	101	304	301	272	90.00	96.00	103.00	27,360	28,896	28,016
California	101	503	498	469	100.00	100.00	105.00	50,300	49,800	49,245
United States	101.1	21,195	20,962	19,833	103.33	109.32	108.03	2,190,102	2,291,638	2,142,524

[1] Compared with Jan. 1, 1914.
[2] Based on census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan. 1, 1910.

TABLE 8.—*Mules: Estimated number on farms, and value, Jan. 1, 1915, with comparisons.*

State.	Number (000 omitted).				Value per head Jan. 1.			Total value Jan. 1 (000 omitted).		
	Jan. 1, 1915.		Jan. 1, 1914.	Apr. 15, 1910 (census).	1915	1914	1910	1915	1914	1910 [2]
	Per cent.[1]	Total.								
New York	101	4	4	4	$152.00	$154.00	$132.00	$608	$616	$528
New Jersey	103	4	4	4	169.00	177.00	155.00	676	708	620
Pennsylvania	102	46	45	44	142.00	148.00	145.00	6,532	6,660	6,380
Delaware	104	6	6	6	121.00	126.00	125.00	726	756	750
Maryland	104	25	24	23	138.00	143.00	130.00	3,450	3,432	2,990
Virginia	101	62	61	60	128.00	136.00	130.00	7,936	8,296	7,800
West Virginia	100	12	12	12	119.00	131.00	120.00	1,428	1,572	1,440
North Carolina	101	194	192	175	151.00	160.00	137.00	29,294	30,720	23,975
South Carolina	97	166	171	156	149.00	167.00	158.00	24,734	28,557	24,648
Georgia	97	309	319	295	140.00	161.00	157.00	43,260	51,359	46,315
Florida	103	28	27	23	163.00	168.00	155.00	4,564	4,536	3,565
Ohio	100	24	24	23	127.00	132.00	125.00	3,048	3,168	2,875
Indiana	100	86	86	82	117.00	121.00	126.00	10,062	10,406	10,332
Illinois	98	145	148	148	110.00	121.00	131.00	15,950	17,908	19,388
Michigan	102	4	4	4	131.00	133.00	122.00	524	532	488
Wisconsin	101	3	3	3	127.00	135.00	115.00	381	405	345
Minnesota	102	6	6	6	124.00	134.00	114.00	744	804	684
Iowa	101	58	57	56	111.00	123.00	123.00	6,438	7,011	6,888
Missouri	101	329	326	343	98.00	112.00	119.00	32,242	36,512	40,817
North Dakota	105	8	8	8	122.00	130.00	130.00	976	1,040	1,040
South Dakota	103	14	14	12	106.00	110.00	121.00	1,484	1,540	1,452
Nebraska	101	85	84	83	105.00	105.00	119.00	8,925	8,820	9,877
Kansas	105	233	222	208	102.00	105.00	116.00	23,766	23,310	24,128
Kentucky	101	231	229	225	106.00	118.00	118.00	24,486	27,022	26,550
Tennessee	102	275	270	276	110.00	127.00	123.00	30,250	34,290	33,948
Alabama	101	281	278	247	114.00	135.00	122.00	32,034	37,530	30,134
Mississippi	102	292	286	256	108.00	115.00	113.00	31,536	32,890	28,928
Louisiana	100	132	132	132	125.00	128.00	116.00	16,500	16,896	15,312
Texas	100	753	753	676	100.00	109.00	99.00	75,300	82,077	66,924
Oklahoma	100	269	269	257	96.00	104.00	105.00	25,824	27,976	26,985
Arkansas	102	240	235	222	96.00	114.00	109.00	23,040	26,790	24,198
Montana	102	4	4	4	98.00	106.00	102.00	392	424	408
Wyoming	103	2	2	2	101.00	113.00	106.00	202	226	212
Colorado	103	18	17	15	100.00	101.00	105.00	1,800	1,717	1,575
New Mexico	104	16	15	15	81.00	92.00	79.00	1,296	1,380	1,185
Arizona	110	7	6	4	104.00	144.00	108.00	728	864	432
Utah	100	2	2	2	79.00	82.00	80.00	158	164	160
Nevada	98	3	3	3	79.00	79.00	79.00	237	237	237
Idaho	103	4	4	4	85.00	103.00	116.00	340	412	464
Washington	104	15	14	12	104.00	116.00	121.00	1,560	1,624	1,452
Oregon	100	10	10	10	96.00	107.00	108.00	960	1,070	1,080
California	101	74	73	70	120.00	120.00	122.00	8,880	8,760	8,540
United States.	100.7	4,479	4,449	4,210	112.36	123.85	120.20	503,271	551,017	506,049

[1] Compared with Jan. 1, 1914.

[2] Based on census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan. 1, 1910.

TABLE 9.—*Milch cows: Estimated number on farms, and value, Jan. 1, 1915, with comparisons.*

State.	Number (000 omitted).				Value per head, Jan. 1.			Total value Jan. 1 (000 omitted).		
	Jan. 1, 1915.		Jan. 1, 1914.	Apr. 15, 1910 (census).	1915	1914	1910	1915	1914	1910[2]
	Per cent.[1]	Total.								
Maine	99	157	159	157	$54.00	$47.50	$33.00	$8,478	$7,552	$5,181
New Hampshire	99	95	96	101	60.00	53.50	36.20	5,700	5,136	3,656
Vermont	101	268	265	265	52.00	47.50	34.20	13,936	12,588	9,063
Massachusetts	97	157	162	172	66.00	59.00	42.00	10,362	9,558	7,224
Rhode Island	98	23	23	23	71.00	70.00	43.80	1,633	1,610	1,007
Connecticut	98	118	120	123	66.70	58.00	41.00	7,871	6,960	5,043
New York	103	1,509	1,465	1,510	61.00	57.00	39.50	92,049	83,505	59,645
New Jersey	100	146	146	154	68.00	67.00	47.50	9,928	9,782	7,315
Pennsylvania	100	943	943	934	59.50	58.40	39.00	56,108	55,071	36,426
Delaware	104	41	39	36	56.50	52.00	38.00	2,316	2,028	1,368
Maryland	104	177	170	167	54.00	53.80	37.30	9,558	9,146	6,229
Virginia	102	349	342	356	43.50	42.00	29.70	15,182	14,364	10,573
West Virginia	101	234	232	240	51.00	50.00	35.00	11,934	11,600	8,400
North Carolina	102	315	309	309	36.50	35.10	25.50	11,498	10,846	7,880
South Carolina	100	185	185	181	33.00	34.20	28.90	6,105	6,327	5,231
Georgia	101	406	402	406	32.00	31.30	25.00	12,992	12,583	10,150
Florida	104	133	128	116	42.50	38.00	32.50	5,652	4,864	3,770
Ohio	101	895	886	905	60.00	60.00	42.80	53,700	53,160	38,734
Indiana	101	646	640	634	55.00	53.90	41.00	35,530	34,496	25,994
Illinois	99	1,007	1,017	1,050	59.50	58.20	42.80	59,916	59,189	44,940
Michigan	102	814	798	767	60.50	59.70	39.50	49,247	47,641	30,296
Wisconsin	105	1,626	1,549	1,473	59.50	59.90	36.60	96,747	92,785	53,912
Minnesota	102	1,186	1,163	1,085	53.50	55.00	33.00	63,451	63,965	35,805
Iowa	102	1,377	1,350	1,407	57.00	60.50	36.00	78,489	81,675	50,652
Missouri	101	797	789	856	54.50	54.00	34.80	43,436	42,606	29,789
North Dakota	111	339	305	259	61.50	59.00	33.90	20,848	17,995	8,780
South Dakota	108	453	419	370	59.50	61.00	33.00	26,954	25,559	12,210
Nebraska	102	625	613	614	62.50	60.70	35.00	39,062	37,209	21,490
Kansas	104	726	698	736	63.50	57.50	36.90	46,101	40,135	27,158
Kentucky	102	390	382	410	45.50	44.50	32.70	17,745	16,999	13,407
Tennessee	102	355	348	397	41.00	41.40	27.50	14,555	14,407	10,918
Alabama	99	384	388	392	31.50	32.40	23.00	12,096	12,571	9,016
Mississippi	103	434	421	430	35.00	34.00	23.50	15,190	14,314	10,105
Louisiana	102	268	263	279	36.00	34.00	24.30	9,648	8,942	6,780
Texas	102	1,086	1,065	1,014	47.50	45.60	29.50	51,585	48,564	29,913
Oklahoma	102	494	484	531	52.00	50.30	31.50	25,688	24,345	16,726
Arkansas	103	387	376	426	37.00	37.50	22.00	14,319	14,100	9,372
Montana	110	114	104	77	75.00	70.50	46.50	8,550	7,332	3,580
Wyoming	112	46	41	33	78.00	74.50	43.70	3,588	3,054	1,442
Colorado	110	205	186	145	68.00	63.00	41.00	13,940	11,718	5,945
New Mexico	110	68	62	51	61.50	55.00	38.80	4,182	3,410	1,979
Arizona	120	44	37	29	74.00	64.00	43.00	3,256	2,368	1,247
Utah	104	92	88	76	62.00	59.00	34.00	5,704	5,192	2,584
Nevada	107	24	22	17	77.50	65.10	44.00	1,860	1,432	748
Idaho	107	120	112	86	72.00	69.80	41.40	8,640	7,818	3,560
Washington	108	253	234	186	74.00	74.00	41.80	18,722	17,316	7,775
Oregon	107	210	196	173	63.50	65.00	39.60	13,335	12,740	6,851
California	105	541	515	467	72.00	62.00	38.40	38,952	31,930	17,933
United States.	102.5	21,262	20,737	20,625	55.33	53.94	35.29	1,176,338	1,118,487	727,802

[1] Compared with Jan. 1, 1914.

[2] Based on census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan. 1, 1910.

TABLE 10.—*Cattle other than milch cows: Estimated number on farms and value, Jan. 1, 1915, with comparisons.*

State.	Number (000 omitted).				Value per head Jan. 1.			Total value Jan. 1 (000 omitted).		
	Jan. 1, 1915.		Jan. 1, 1914	Apr. 15, 1910 (census).	1915	1914	1910	1915	1914	1910 [2]
	Per cent.[1]	Total.								
Maine	101	101	100	100	$26.10	$23.40	$16.90	$2,636	$2,340	$1,690
New Hampshire	99	64	65	67	28.00	26.80	20.30	1,792	1,742	1,360
Vermont	101	167	165	165	23.10	21.10	14.40	3,858	3,482	2,376
Massachusetts	101	83	82	80	25.10	23.10	16.70	2,083	1,894	1,336
Rhode Island	98	11	11	11	26.80	28.10	17.50	295	309	192
Connecticut	99	71	72	72	29.80	27.90	19.10	2,116	2,009	1,375
New York	102	894	876	913	28.20	27.20	18.20	25,211	23,827	16,617
New Jersey	103	70	68	69	31.50	30.50	21.40	2,205	2,074	1,477
Pennsylvania	101	638	632	653	29.30	28.30	19.20	18,693	17,886	12,538
Delaware	104	20	19	19	31.20	29.20	21.00	624	555	399
Maryland	102	121	119	121	29.50	29.40	21.10	3,570	3,499	2,553
Virginia	100	450	450	503	28.60	27.60	19.40	12,870	12,420	9,758
West Virginia	102	338	331	380	36.30	35.90	22.50	12,269	11,883	8,550
North Carolina	101	369	365	392	17.00	17.30	12.50	6,273	6,314	4,900
South Carolina	100	211	211	209	14.60	14.90	12.00	3,081	3,144	2,508
Georgia	100	660	660	674	12.80	12.70	10.30	8,448	8,382	6,942
Florida	100	735	735	729	14.50	13.70	10.30	10,658	10,070	7,509
Ohio	100	838	838	933	34.60	35.40	24.10	28,995	29,665	22,485
Indiana	98	693	707	729	35.20	33.90	24.50	24,394	23,967	17,860
Illinois	97	1,180	1,216	1,391	37.80	35.90	26.40	44,604	43,654	36,722
Michigan	104	707	680	731	29.80	28.10	18.50	21,069	19,108	13,524
Wisconsin	105	1,216	1,158	1,207	27.70	27.10	16.40	33,683	31,382	19,795
Minnesota	103	1,208	1,173	1,262	24.70	24.30	14.30	29,838	28,504	18,047
Iowa	105	2,683	2,555	3,041	37.50	39.20	22.20	100,612	100,156	67,510
Missouri	102	1,414	1,386	1,705	37.90	36.10	22.60	53,591	50,035	38,533
North Dakota	110	515	468	485	36.00	34.60	20.50	18,540	16,193	9,942
South Dakota	106	967	912	1,165	39.50	39.50	21.50	38,196	36,024	25,048
Nebraska	108	2,034	1,883	2,318	40.80	38.10	21.90	82,987	71,742	50,764
Kansas	113	1,768	1,565	2,343	42.50	36.90	23.70	75,140	57,748	55,529
Kentucky	103	543	527	591	30.40	28.80	19.90	16,507	15,178	11,761
Tennessee	101	503	498	600	22.40	21.40	13.80	11,267	10,657	8,280
Alabama	98	504	514	540	12.60	12.00	9.00	6,350	6,168	4,860
Mississippi	105	514	490	583	14.30	13.50	8.40	7,350	6,615	4,897
Louisiana	100	448	448	526	16.40	15.30	10.30	7,347	6,854	5,418
Texas	99	5,121	5,173	5,921	31.70	26.50	15.30	162,336	137,084	90,591
Oklahoma	102	1,119	1,097	1,423	35.40	33.40	19.20	39,613	36,640	27,322
Arkansas	102	484	475	602	17.20	15.80	9.00	8,325	7,505	5,418
Montana	105	791	753	866	49.00	46.40	27.40	38,759	34,939	23,728
Wyoming	115	628	546	734	53.30	49.40	26.40	33,472	26,972	19,378
Colorado	105	996	949	983	43.70	40.00	23.00	43,525	37,960	22,609
New Mexico	108	991	918	1,031	35.50	32.70	17.40	35,180	30,019	17,939
Arizona	107	791	739	796	34.50	32.50	19.30	27,290	24,018	15,363
Utah	107	381	356	336	35.80	35.50	18.30	13,640	12,638	6,149
Nevada	103	450	437	435	40.70	38.90	20.70	18,315	16,999	8,963
Idaho	107	379	354	368	41.80	41.20	21.40	15,842	14,585	7,875
Washington	108	215	199	216	34.90	35.70	19.90	7,504	7,104	4,298
Oregon	107	503	470	552	36.30	38.00	18.50	18,259	17,860	10,212
California	105	1,480	1,410	1,610	39.30	33.00	20.10	58,164	46,530	32,361
United States	103.4	37,067	35,855	41,178	33.38	31.13	19.07	1,237,376	1,116,333	785,261

[1] Compared with Jan. 1, 1914.
[2] Based on census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan. 1, 1910.

TABLE 11.—*Sheep: Estimated number on farms, and value, Jan. 1, 1915, with comparisons.*

State.	Number (000 omitted).				Value per head, Jan. 1.			Total value Jan. 1 (000 omitted).		
	Jan. 1, 1915.		Jan 1, 1914.	Apr.15, 1910 (census)	1915	1914	1910	1915	1914	1910 [2]
	Per cent.[1]	Total.								
Maine	93	165	177	206	$4.50	$4.30	$3.70	$742	$761	$762
New Hampshire	97	38	39	44	4.90	4.40	3.70	186	172	163
Vermont	95	105	111	119	5.10	4.80	4.00	536	533	476
Massachusetts	97	30	31	33	5.60	5.30	4.20	168	164	139
Rhode Island	96	7	7	7	5.20	5.40	4.20	36	38	29
Connecticut	96	19	20	22	5.70	5.40	4.70	108	108	103
New York	97	849	875	930	5.80	5.40	5.00	4,924	4,725	4,650
New Jersey	100	31	31	31	6.00	5.60	5.20	186	174	161
Pennsylvania	99	831	839	883	5.30	4.90	4.80	4,404	4,111	4,238
Delaware	100	8	8	8	5.30	5.10	4.60	42	41	37
Maryland	100	223	223	237	5.20	5.00	4.70	1,160	1,115	1,114
Virginia	98	720	735	805	4.50	4.50	3.90	3,240	3,308	3,140
West Virginia	101	796	788	910	4.50	4.30	4.30	3,582	3,388	3,913
North Carolina	100	177	177	214	3.30	3.20	2.60	584	566	556
South Carolina	97	32	33	38	2.60	2.60	2.40	83	86	91
Georgia	98	163	166	188	2.30	2.10	2.20	375	349	414
Florida	101	119	118	114	2.20	1.90	2.00	262	224	228
Ohio	100	3,263	3,263	3,909	4.70	4.30	4.80	15,336	14,031	18,763
Indiana	90	1,114	1,238	1,337	5.40	4.90	5.20	6,016	6,066	6,952
Illinois	95	935	984	1,060	5.40	5.00	5.30	5,049	4,920	5,618
Michigan	96	2,033	2,118	2,306	5.00	4.60	4.70	10,165	9,743	10,838
Wisconsin	99	781	789	930	5.00	4.70	4.50	3,905	3,708	4,185
Minnesota	99	564	570	638	4.60	4.40	4.00	2,594	2,508	2,552
Iowa	100	1,249	1,249	1,146	5.00	5.30	5.30	6,994	6,620	6,074
Missouri	95	1,490	1,568	1,811	5.00	4.20	4.40	7,450	6,586	7,968
North Dakota	90	250	278	293	4.50	4.20	4.00	1,125	1,168	1,172
South Dakota	103	636	617	611	4.50	4.00	4.00	2,862	2,468	2,444
Nebraska	100	374	374	294	4.80	4.50	4.40	1,795	1,683	1,294
Kansas	100	316	316	272	4.90	4.50	4.70	1,548	1,422	1,278
Kentucky	97	1,229	1,267	1,363	4.20	4.20	4.00	5,162	5,321	5,452
Tennessee	98	674	688	795	3.70	3.40	3.40	2,494	2,339	2,703
Alabama	96	119	124	143	2.30	2.40	2.00	274	298	286
Mississippi	103	208	202	195	2.20	2.30	1.90	458	465	370
Louisiana	100	180	180	178	2.20	2.20	1.90	396	396	338
Texas	103	2,114	2,052	1,809	3.20	2.90	2.90	6,765	5,951	5,246
Oklahoma	101	76	75	62	4.20	4.00	3.30	319	300	205
Arkansas	105	130	124	144	2.60	2.60	2.30	338	322	331
Montana	102	4,379	4,293	5,381	4.40	3.70	4.20	19,268	15,884	22,600
Wyoming	99	4,427	4,472	5,397	4.70	4.10	4.40	20,807	18,335	23,747
Colorado	105	1,751	1,668	1,426	4.40	3.70	3.80	7,704	6,172	5,419
New Mexico	110	3,340	3,036	3,347	3.50	3.00	2.90	11,690	9,108	9,706
Arizona	110	1,761	1,601	1,227	4.00	3.60	3.70	7,044	5,764	4,540
Utah	105	2,068	1,970	1,827	4.50	3.90	4.10	9,306	7,683	7,491
Nevada	101	1,532	1,517	1,155	4.90	4.50	3.70	7,507	6,826	4,274
Idaho	102	3,041	2,981	3,011	4.70	4.20	4.70	14,293	12,520	14,152
Washington	108	546	506	476	4.80	4.40	3.90	2,621	2,226	1,856
Oregon	96	2,563	2,670	2,699	4.50	3.90	3.70	11,534	10,413	9,986
California	98	2,500	2,551	2,417	4.50	3.80	3.30	11,250	9,694	7,976
United States	100.5	49,956	49,719	52,448	4.50	4.04	4.12	224,687	200,803	216,030

[1] Compared with Jan. 1, 1914.

[2] Based on census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan. 1, 1910.

TABLE 12.—*Swine: Estimated number on farms, and value, Jan. 1, 1915, with comparisons.*

State.	Number (000 omitted).				Value per head Jan. 1.			Total value Jan. 1 (000 omitted).		
	Jan. 1, 1915.		Jan. 1, 1914.	Apr. 15, 1910 (census).	1915	1914	1910	1915	1914	1910 [2]
	Per cent.[1]	Total.								
Maine	98	95	97	87	$15.70	$15.80	$11.50	$1,492	$1,533	$1,000
New Hampshire	101	52	51	45	14.00	14.80	11.50	728	755	518
Vermont	102	108	106	95	13.00	14.10	10.00	1,404	1,495	950
Massachusetts	102	108	106	103	15.50	14.50	11.50	1,674	1,537	1,184
Rhode Island	104	15	14	14	13.50	15.20	12.50	202	213	175
Connecticut	101	58	57	52	15.50	16.30	12.50	899	929	650
New York	102	768	753	666	14.30	14.50	11.50	10,982	10,918	7,659
New Jersey	102	161	158	147	14.00	13.60	12.00	2,254	2,149	1,764
Pennsylvania	105	1,186	1,130	978	13.50	13.80	9.50	16,011	15,594	9,291
Delaware	103	60	58	49	10.20	10.30	8.70	612	597	426
Maryland	105	349	332	302	9.70	10.50	8.90	3,385	3,486	2,688
Virginia	110	956	869	798	7.90	8.30	6.50	7,552	7,213	5,187
West Virginia	102	374	367	328	9.60	10.10	7.70	3,590	3,707	2,526
North Carolina	112	1,525	1,362	1,228	8.20	9.00	7.20	12,505	12,258	8,842
South Carolina	105	819	780	665	8.60	9.10	7.20	7,043	7,098	4,788
Georgia	105	2,042	1,945	1,784	8.00	8.20	7.00	16,336	15,949	12,488
Florida	105	949	904	810	6.00	6.00	4.80	5,694	5,424	3,888
Ohio	105	3,640	3,467	3,106	11.20	11.30	10.70	40,768	39,177	33,234
Indiana	105	4,167	3,969	3,614	10.30	10.30	10.00	42,920	40,881	36,140
Illinois	100	4,358	4,358	4,686	10.30	10.80	10.90	44,887	47,066	51,077
Michigan	106	1,392	1,313	1,246	10.90	12.30	10.50	15,173	16,150	13,083
Wisconsin	110	2,255	2,050	1,809	12.00	13.00	11.80	27,060	26,650	21,346
Minnesota	120	1,716	1,430	1,520	12.50	14.00	11.50	21,450	20,020	17,480
Iowa	125	8,720	6,976	7,546	11.00	12.60	11.30	95,920	87,898	85,270
Missouri	100	4,250	4,250	4,438	8.10	8.50	7.90	34,425	36,125	35,060
North Dakota	150	642	428	332	11.80	13.20	11.00	7,576	5,650	3,652
South Dakota	115	1,195	1,039	1,010	11.00	11.30	11.10	13,145	11,741	11,211
Nebraska	118	3,809	3,228	3,436	10.90	11.80	11.00	41,518	38,090	37,796
Kansas	113	2,656	2,350	3,000	10.10	10.60	10.00	26,826	23,500	30,000
Kentucky	105	1,582	1,507	1,492	7.20	7.70	6.80	11,390	11,604	10,146
Tennessee	108	1,501	1,390	1,388	7.80	8.50	6.50	11,708	11,815	9,022
Alabama	105	1,559	1,485	1,267	7.80	8.50	6.00	12,160	12,622	7,602
Mississippi	105	1,540	1,467	1,292	7.20	8.10	5.50	11,088	11,883	7,106
Louisiana	101	1,412	1,398	1,328	7.70	8.00	5.50	10,872	11,184	7,304
Texas	110	2,880	2,618	2,336	9.00	8.60	6.60	25,920	22,515	15,418
Oklahoma	105	1,420	1,352	1,839	8.20	8.40	7.70	11,644	11,357	14,160
Arkansas	105	1,573	1,498	1,519	6.50	7.40	4.80	10,224	11,085	7,291
Montana	150	276	184	99	10.80	11.90	10.10	2,981	2,190	1,000
Wyoming	125	64	51	34	11.40	12.40	8.50	730	632	289
Colorado	125	256	205	179	10.50	10.50	9.50	2,688	2,152	1,700
New Mexico	130	73	56	46	9.80	10.10	8.50	715	566	391
Arizona	130	31	24	17	12.00	9.60	9.50	372	230	162
Utah	115	98	85	64	10.20	10.90	9.00	1,000	926	576
Nevada	110	36	33	23	11.60	12.60	9.00	418	416	207
Idaho	130	328	252	178	10.00	10.70	8.70	3,280	2,696	1,549
Washington	115	327	284	206	11.10	12.70	9.40	3,630	3,607	1,936
Oregon	120	360	300	218	9.50	11.00	8.20	3,420	3,300	1,788
California	110	877	797	767	10.50	10.50	8.20	9,208	8,368	6,289
United States.	109.6	64,618	58,933	58,186	9.87	10.40	9.17	637,479	612,951	533,309

[1] Compared with Jan. 1, 1914.
[2] Based on census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan. 1, 1910.

PRICES OF FARM PRODUCTS.

TABLE 13.—*Prices paid to producers of farm products, by States.*

State.	January 1.													
	Corn, per bushel.		Wheat, per bushel.		Oats, per bushel.		Barley, per bushel.		Rye, per bushel.		Buckwheat, per bushel.		Potatoes, per bushel.	
	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Maine	83	77	.....	114	64	52	84	82	.....	.....	80	73	35	55
N. Hampshire	82	74	.....	.....	63	52	90	80	.....	.....	.....	70	60	70
Vermont	80	74	115	100	61	53	85	81	.....	.....	83	85	50	62
Massachusetts	85	77	.....	.....	60	53	.....	.....	100	94	87	87	69	81
Rhode Island	99	90	.....	.....	50	51	.....	.....	.....	.....	.....	.....	60	82
Connecticut	91	76	.....	.....	59	50	.....	.....	98	90	100	92	67	85
New York	82	72	110	99	52	45	75	75	96	78	80	71	45	64
New Jersey	79	68	110	100	56	47	.....	.....	86	78	84	73	61	79
Pennsylvania	73	67	113	97	50	46	78	67	86	77	74	67	60	71
Delaware	70	56	125	95	50	48	.....	.....	100	78	.....	71	87	84
Maryland	70	62	115	97	56	48	67	60	83	74	80	73	65	66
Virginia	81	72	115	102	59	52	77	68	91	81	85	77	73	74
West Virginia	83	73	114	103	54	52	.....	.....	92	86	80	75	80	82
North Carolina	85	83	120	111	65	62	.....	.....	98	98	80	80	88	82
South Carolina	87	90	132	128	68	68	.....	.....	130	140	.....	.....	122	122
Georgia	79	84	126	124	69	68	.....	.....	120	140	.....	.....	108	103
Florida	89	83	.....	.....	77	72	.....	.....	.....	.....	.....	.....	102	119
Ohio	62	54	117	98	47	39	59	66	93	75	78	75	55	68
Indiana	61	51	114	95	45	37	64	61	88	70	85	77	57	65
Illinois	64	51	111	93	45	36	62	60	90	72	105	94	65	74
Michigan	68	60	113	97	45	39	72	64	95	70	73	67	28	46
Wisconsin	64	55	104	90	44	37	61	69	94	68	75	74	33	44
Minnesota	54	46	104	88	41	33	52	60	95	62	75	75	30	47
Iowa	57	47	103	84	43	34	57	62	83	67	100	94	68	68
Missouri	69	57	108	92	47	40	70	64	91	79	.....	102	76	83
North Dakota	61	53	110	84	39	34	45	53	88	59	.....	.....	48	58
South Dakota	53	45	101	83	39	33	50	58	84	60	.....	.....	55	65
Nebraska	55	49	105	81	42	35	45	47	75	61	68	94	62	75
Kansas	52	56	107	85	43	41	50	52	82	73	.....	.....	81	92
Kentucky	67	64	110	99	54	49	.....	.....	96	87	.....	.....	75	82
Tennessee	67	66	115	105	54	50	75	80	99	97	74	78	95	85
Alabama	82	81	135	119	68	64	.....	.....	133	140	.....	.....	101	111
Mississippi	76	75	112	105	66	61	.....	.....	.....	.....	.....	.....	102	103
Louisiana	88	71	.....	.....	68	56	.....	.....	.....	.....	.....	.....	110	92
Texas	80	76	107	100	50	52	50	94	107	106	.....	.....	107	113
Oklahoma	66	61	106	89	44	45	55	62	95	90	.....	.....	92	105
Arkansas	82	71	105	95	50	52	.....	.....	102	92	.....	.....	92	101
Montana	84	95	93	77	41	36	52	65	62	71	.....	.....	60	70
Wyoming	67	76	91	91	50	45	69	69	80	79	.....	.....	74	86
Colorado	63	62	92	80	50	46	57	61	62	64	.....	.....	45	60
New Mexico	75	92	101	106	45	59	55	70	.....	.....	.....	.....	85	103
Arizona	124	115	125	108	78	76	63	80	.....	.....	.....	.....	103	116
Utah	78	79	90	79	40	45	47	59	58	66	.....	.....	59	59
Nevada	.....	.....	110	103	55	63	70	82	.....	.....	.....	.....	82	81
Idaho	94	77	96	70	37	38	60	53	.....	68	.....	.....	54	55
Washington	90	78	106	77	41	43	51	57	85	78	.....	.....	48	54
Oregon	80	80	110	82	45	44	61	59	105	89	.....	.....	50	56
California	87	86	110	97	46	57	57	69	88	87	.....	.....	65	79
U. S.	65.8	58.2	107.8	87.4	45.0	38.5	54.3	61.2	90.2	71.4	77.9	70.6	49.7	62.7

TABLE 14.—*Prices paid to producers of farm products, by States*—Continued.

State.	January 1.											
	Hay, per ton.		Flaxseed, per bushel.		Cotton, per pound.		Butter, per pound.		Eggs, per dozen.		Chickens, per pound.	
	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.
			Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	$13.70	$14.40	.....	.....	.....	.....	31	32	41	37	14.0	13.9
New Hampshire	15.50	16.86	.....	.....	.....	.....	34	33	41	37	15.9	14.1
Vermont	13.70	13.80	.....	.....	.....	.....	35	33	40	37	13.4	12.5
Massachusetts	20.20	20.44	.....	.....	.....	.....	36	36	48	43	17.8	15.6
Rhode Island	21.50	21.06	.....	.....	.....	.....	36	35	45	45	16.8	17.1
Connecticut	20.50	20.66	.....	.....	.....	.....	36	36	50	42	17.7	15.6
New York	14.80	15.28	.....	.....	.....	.....	35	34	42	38	15.0	13.6
New Jersey	19.30	19.30	.....	.....	.....	.....	37	36	45	40	17.0	16.5
Pennsylvania	15.30	16.14	.....	.....	.....	.....	35	34	39	35	13.7	12.4
Delaware	19.00	16.20	.....	.....	.....	.....	35	30	38	33	13.5	12.1
Maryland	16.20	16.40	.....	.....	.....	.....	30	29	36	31	13.5	13.5
Virginia	17.00	15.74	.....	.....	6.6	12.4	27	26	31	28	13.1	12.7
West Virginia	16.90	15.78	.....	.....	.....	.....	29	27	32	29	12.7	11.6
North Carolina	17.80	15.92	.....	.....	6.7	12.3	24	24	27	25	11.3	10.6
South Carolina	16.60	17.72	.....	.....	7.0	12.4	26	26	25	27	12.7	12.5
Georgia	16.60	17.04	.....	.....	6.5	12.4	25	25	27	28	12.7	13.0
Florida	16.70	16.62	.....	.....	10.0	16.1	36	34	32	32	17.5	14.5
Ohio	13.40	13.88	.....	.....	.....	.....	29	28	33	31	10.7	10.5
Indiana	14.30	13.28	.....	.....	.....	.....	26	26	32	28	10.4	10.0
Illinois	14.80	13.50	.....	.....	.....	.....	28	28	32	29	10.7	10.1
Michigan	12.20	13.52	.....	.....	.....	.....	30	29	32	30	11.4	10.5
Wisconsin	9.30	12.84	135	166	.....	.....	31	32	30	30	10.8	10.2
Minnesota	6.20	8.26	139	165	.....	.....	31	31	31	28	9.3	9.1
Iowa	10.70	10.18	126	154	.....	.....	29	29	28	26	9.4	9.3
Missouri	14.50	11.08	.....	113	6.2	13.0	24	24	28	26	9.5	9.3
North Dakota	5.20	6.62	137	163	.....	.....	28	28	31	30	8.9	9.4
South Dakota	6.20	7.22	136	161	.....	.....	28	28	28	28	9.1	8.7
Nebraska	7.10	8.72	132	136	.....	.....	26	26	27	27	8.9	8.6
Kansas	8.40	9.10	126	139	.....	.....	27	26	27	27	9.3	8.8
Kentucky	16.50	14.66	.....	.....	.....	.....	22	22	29	26	10.1	9.8
Tennessee	16.80	15.14	.....	.....	6.5	12.3	21	21	27	25	10.2	10.0
Alabama	13.60	13.90	.....	.....	6.4	12.4	23	23	25	26	12.2	11.9
Mississippi	12.43	12.00	.....	.....	6.6	12.5	24	24	24	25	12.4	11.7
Louisiana	11.10	11.68	.....	.....	6.7	12.4	29	28	26	26	14.2	13.2
Texas	9.80	11.80	.....	.....	6.6	12.1	24	24	27	26	10.0	9.3
Oklahoma	8.20	8.46	.....	.....	6.2	11.5	24	26	25	27	8.9	8.7
Arkansas	12.00	12.18	.....	.....	6.4	12.2	24	24	26	26	9.5	9.2
Montana	6.90	9.64	125	128	.....	.....	35	36	43	44	13.7	14.1
Wyoming	7.00	9.20	.....	.....	.....	.....	33	34	37	39	11.9	14.7
Colorado	7.50	9.92	.....	.....	.....	.....	32	32	37	37	13.5	12.7
New Mexico	11.50	11.94	.....	.....	.....	.....	36	35	36	36	13.2	13.3
Arizona	9.00	12.68	.....	.....	.....	.....	36	40	36	46	17.6	18.0
Utah	8.30	9.82	.....	.....	.....	.....	33	33	36	56	12.6	12.5
Nevada	7.60	9.64	.....	.....	.....	.....	35	38	49	52	17.5	20.3
Idaho	7.20	7.68	.....	.....	.....	.....	32	35	39	39	11.2	11.4
Washington	10.90	12.42	.....	.....	.....	.....	35	37	41	41	12.2	13.0
Oregon	9.30	10.14	.....	.....	.....	.....	32	35	40	39	12.7	12.6
California	8.30	12.42	.....	.....	.....	.....	33	35	41	40	16.9	14.8
United States	11.29	12.55	134.8	162.0	6.6	12.3	28.7	28.4	31.6	29.6	11.2	10.7

TABLE 15.—*Prices paid to producers of farm products, by States*—Continued.

State.	December 15.															
	Hogs, per 100 lbs.		Beef cattle, per 100 lbs.		Veal calves, per 100 lbs.		Sheep, per 100 lbs.		Lambs, per 100 lbs.		Milch cows, per head.[1]		Horses, per head.[1]		Wool, per pound.	
	1914	4-year average.	1914	4-year average.	1914	4-year average.	1914	4-year average.	1914	4-year average.	1914	4-year average.	1914	4-year average.	1914	4-year average.
															Cts.	*Cts.*
Maine	$7.50	$7.12	$7.00	$6.57	$8.60	$8.00	$5.40	$4.58	$6.80	$6.20	$53.00	$51.85	$200	$185	23	22
N. Hampshire	7.80	7.62	6.80	6.52	8.70	7.80	5.30	4.80	7.00	6.50	60.00	54.62	175	172	19	20
Vermont	7.10	6.52	5.40	4.80	8.00	6.98	4.00	3.68	6.20	5.48	51.00	47.65	170	162	22	20
Massachusetts	8.50	8.00	6.50	5.55	9.20	8.15	5.50	.....	7.00	.....	71.80	47.50	155	194	.....	.....
Rhode Island	9.00	8.38	6.30	6.57	9.50	8.82	5.30	5.00	7.20	6.60	80.00	67.20	200	.....	22	.....
Connecticut	10.10	8.60	7.80	8.00	10.00	8.93	6.50	5.67	7.90	7.07	66.50	56.97	205	193	22	.....
New York	7.60	7.28	6.10	5.28	9.90	8.48	4.80	4.22	7.30	5.88	64.80	54.35	175	176	22	20
New Jersey	8.60	8.40	7.00	6.68	10.20	8.60	5.00	4.60	.....	6.23	75.00	58.88	170	173	.....	19
Pennsylvania	7.80	7.52	7.00	5.95	9.20	8.12	5.10	4.52	7.00	6.02	61.20	51.78	167	168	22	21
Delaware	8.40	7.70	6.50	5.40	10.00	9.67	5.90	4.57	8.00	6.93	55.00	45.00	127	.....	20	19
Maryland	8.70	7.48	6.60	5.45	9.70	8.88	4.80	3.93	7.00	6.17	45.00	38.25	115	140	.....	.....
Virginia	7.50	7.20	6.00	5.00	8.10	7.18	4.20	3.82	6.70	5.75	45.80	38.50	135	138	22	22
West Virginia	7.60	7.18	6.10	5.12	8.10	6.68	4.50	3.82	6.10	5.35	54.00	42.28	143	138	24	22
North Carolina	7.80	7.42	4.70	3.95	5.60	4.78	4.20	3.98	5.70	4.92	39.00	33.78	145	148	21	20
South Carolina	8.10	8.02	4.30	3.98	4.90	4.58	5.20	4.52	5.60	5.32	39.40	36.00	141	165	16	16
Georgia	7.60	7.20	4.30	3.75	5.00	4.65	4.20	4.18	5.00	4.98	37.50	32.68	137	155	19	21
Florida	7.10	6.20	5.60	4.35	6.60	4.70	6.50	3.63	6.70	3.60	51.60	40.02	143	150	20	21
Ohio	6.30	6.80	6.60	5.65	8.20	7.93	4.30	3.58	6.40	5.60	60.30	51.62	148	158	24	21
Indiana	6.50	6.78	6.50	5.45	7.70	7.15	4.00	3.58	6.40	5.40	54.50	48.42	135	145	22	20
Illinois	6.60	6.70	6.80	5.60	7.90	7.05	4.90	3.85	6.60	5.45	63.90	52.12	138	147	20	19
Michigan	6.30	6.65	6.00	4.90	7.70	7.42	4.30	3.75	6.50	5.72	59.70	48.02	164	166	22	20
Wisconsin	6.60	6.80	5.40	4.62	7.60	7.32	4.50	3.95	6.40	5.60	64.40	51.95	161	168	20	20
Minnesota	6.40	6.58	5.20	4.42	7.20	6.30	4.40	3.82	6.10	5.28	58.30	47.32	146	156	17	17
Iowa	6.50	6.65	6.90	5.88	7.90	6.60	4.90	4.20	6.50	5.60	62.40	52.02	146	158	18	18
Missouri	6.50	6.50	6.60	5.58	7.50	6.38	4.70	3.75	6.30	5.18	55.00	47.30	109	122	19	19
North Dakota	6.00	6.40	5.50	4.42	7.30	5.95	4.70	4.15	5.90	5.32	62.60	49.20	129	139	17	15
South Dakota	6.30	6.48	6.20	4.92	7.50	5.92	5.00	4.02	6.50	5.15	62.90	43.58	120	131	17	16
Nebraska	6.40	6.48	6.70	5.50	7.80	6.60	5.30	4.40	7.20	5.75	67.90	50.82	125	123	.....	16
Kansas	6.60	6.62	6.90	5.62	7.80	6.55	5.20	4.38	7.00	5.68	65.20	50.52	114	122	14	17
Kentucky	6.50	6.65	5.60	4.75	6.80	6.35	3.80	3.40	5.30	5.05	47.10	38.90	110	124	20	20
Tennessee	6.60	6.55	5.30	4.10	6.50	5.12	3.80	3.40	5.00	4.65	44.50	36.55	128	142	18	18
Alabama	6.80	6.60	4.00	3.25	4.50	4.05	4.70	3.70	5.50	4.50	37.00	31.45	121	134	17	18
Mississippi	6.20	6.12	4.00	3.30	5.30	4.35	3.70	3.32	4.60	4.12	36.80	30.50	103	116	16	16
Louisiana	6.30	6.05	5.10	4.00	5.10	4.75	5.70	4.88	.....	5.83	35.00	34.30	80	90	14	15
Texas	6.60	6.68	5.40	4.30	6.40	5.15	5.00	4.38	5.90	5.08	54.00	43.52	89	92	14	15
Oklahoma	6.40	6.65	5.80	4.65	6.80	5.78	4.90	4.35	6.10	5.48	58.50	45.50	99	104	18	.....
Arkansas	6.00	6.12	4.60	3.72	5.70	5.05	4.00	3.72	4.70	4.58	39.80	32.75	90	106	17	17
Montana	6.50	7.15	6.70	5.48	8.30	7.08	5.20	4.52	6.50	5.70	81.00	58.88	137	132	19	18
Wyoming	6.50	7.30	6.40	5.68	8.80	7.68	5.90	4.40	6.80	5.98	83.80	63.00	110	97	17	14
Colorado	6.80	7.18	6.50	5.38	8.30	7.30	5.20	4.58	7.40	5.65	72.90	53.90	110	115	16	14
New Mexico	7.00	7.30	6.30	5.08	8.30	7.17	4.70	4.28	5.70	5.25	62.00	53.10	76	81	15	13
Arizona	7.70	8.15	6.10	5.23	8.00	6.30	4.20	4.40	5.50	5.80	93.00	63.75	106	118	.....	.....
Utah	6.50	6.82	5.60	4.82	8.90	7.72	4.90	4.72	6.20	5.40	63.00	49.08	115	111	16	14
Nevada	8.40	7.88	6.20	5.52	8.00	7.33	5.40	4.73	6.00	.....	90.00	62.50	140	123	15	.....
Idaho	6.30	6.95	5.80	5.28	7.70	6.85	5.10	4.28	6.00	5.30	75.70	57.55	123	123	21	16
Washington	6.40	7.60	6.10	5.52	7.50	7.93	5.00	4.58	6.00	5.60	75.00	63.30	115	137	17	16
Oregon	6.60	7.35	6.50	5.48	8.20	7.30	6.00	4.50	6.50	5.32	70.00	54.42	95	110	17	16
California	7.00	6.98	6.60	6.00	8.10	6.55	5.60	4.62	6.50	5.38	74.20	59.08	120	147	17	13
United States	6.67	6.73	6.01	5.03	7.61	6.74	4.95	4.23	6.33	5.52	58.23	47.98	129.57	137.14	18.6	17.0

[1] Prices in this table are for marketable grades or classes, and not strictly comparable with prices on pages 14 and 16, which are based upon valuation of all animals, of all ages and grades.

TABLE 16.—*Prices paid to producers of farm products, by States*—Continued.

State.	December 15.													
	Turkeys, per pound.		Chickens, per pound.		Eggs, per dozen.		Timothy hay, per ton, 1914.	Clover hay, per ton, 1914.	Alfalfa hay, per ton, 1914.	Prairie hay, per ton, 1914.	Soy beans, per bushel.		Cotton seed, per ton.	
	1914	1913	1914	1913	1914	1913					1914	1913	1914	1913
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*								
Maine	19.2	21.0	13.4	13.2	44	42	$14.00	$11.90	$12.20	.....	.....	.....	.....	.....
N. Hampshire	24.0	21.0	16.5	15.2	45	43	18.00	15.30	12.00	.....	.....	.....	.....	.....
Vermont	17.7	19.0	10.8	13.0	42	42	13.50	13.30	.....	.....	.....	.....	.....	.....
Massachusetts	26.7	24.0	16.5	17.0	51	51	21.00	18.00	.....	.....	.....	.....	.....	.....
Rhode Island	20.0	23.0	16.1	16.1	52	49	23.00	.....	.....	.....	.....	.....	.....	.....
Connecticut	27.0	28.0	17.4	17.0	50	48	20.30	17.00	.....	.....	$1.00	.....	.....	.....
New York	20.7	21.0	13.2	13.6	43	42	16.00	13.20	15.00	.....	.....	$2.00	.....	.....
New Jersey	22.0	22.0	15.4	16.5	46	42	19.40	17.30	21.30	.....	.....	.....	.....	.....
Pennsylvania	19.1	20.2	12.6	13.1	38	39	14.90	12.80	.....	.....	2.60	.....	.....	.....
Delaware	19.0	20.5	13.0	14.5	40	36	16.50	14.50	18.00	.....	2.40	.....	.....	.....
Maryland	18.2	18.2	13.0	14.3	34	34	16.80	14.00	.....	.....	.....	.....	.....	.....
Virginia	15.4	16.5	11.5	13.1	31	32	19.20	16.80	19.50	.....	2.65	2.29	$27.00	$29.30
West Virginia	15.2	16.3	11.4	12.4	32	34	19.00	17.10	.....	.....	2.35	.....	.....	.....
North Carolina	14.8	15.1	11.5	11.9	28	30	20.00	18.00	20.50	.....	1.80	1.64	20.10	28.70
South Carolina	14.8	15.4	13.4	12.8	29	32	21.00	19.50	27.00	$15.40	2.10	1.45	19.90	28.00
Georgia	15.1	15.8	12.6	13.5	29	34	21.00	20.00	22.00	15.00	2.00	1.75	20.00	27.20
Florida	20.0	18.8	17.5	17.0	36	38	.....	.....	.....	.....	.....	2.75	16.70	22.30
Ohio	15.4	16.7	10.6	11.0	33	34	13.90	12.30	15.40	9.00	2.40	1.75	.....	.....
Indiana	14.0	15.5	9.9	10.5	32	32	15.00	12.80	15.10	10.00	2.40	1.88	.....	.....
Illinois	15.1	14.5	10.3	10.9	31	32	15.50	13.90	15.60	11.80	2.50	2.33	.....	.....
Michigan	15.3	16.4	9.8	10.5	30	32	12.10	10.50	13.00	.....	.....	.....	.....	.....
Wisconsin	14.9	15.9	9.8	10.8	30	31	10.30	8.90	13.30	6.80	.....	.....	.....	.....
Minnesota	13.4	13.8	8.9	9.6	30	30	8.50	8.20	11.00	6.40	1.55	.....	.....	.....
Iowa	15.2	15.8	9.8	10.7	29	28	11.60	10.70	13.50	8.80	.....	.....	.....	.....
Missouri	13.8	14.9	9.4	10.2	28	29	14.70	14.00	14.70	10.50	1.50	2.60	25.00	21.00
North Dakota	12.9	13.2	9.6	10.5	30	31	8.80	10.00	9.80	6.40	2.62	.....	.....	.....
South Dakota	14.0	13.9	9.4	9.3	28	30	8.70	8.70	9.40	6.70	.....	.....	.....	.....
Nebraska	13.2	13.9	8.5	9.1	27	30	8.50	8.40	8.40	6.80	2.60	.....	.....	.....
Kansas	12.5	13.2	9.3	9.5	27	31	10.90	10.10	9.50	7.70	.....	2.00	.....	.....
Kentucky	12.1	14.0	9.6	9.8	28	29	18.60	16.80	19.00	.....	2.10	2.10	.....	.....
Tennessee	12.3	13.7	9.7	10.5	28	28	19.30	18.10	19.90	12.60	1.86	2.10	18.30	24.20
Alabama	12.1	14.6	11.6	12.4	27	30	20.00	18.00	20.50	14.50	.....	2.15	18.50	26.00
Mississippi	12.8	14.0	11.3	12.2	27	29	16.60	14.60	19.40	9.80	.....	.....	19.30	22.50
Louisiana	16.7	15.0	13.9	13.7	28	30	.....	12.00	15.00	8.50	.....	.....	17.80	18.50
Texas	11.3	11.8	9.9	10.1	29	30	.....	.....	14.00	9.50	.....	.....	15.10	20.00
Oklahoma	11.3	12.2	9.3	9.3	25	30	.....	.....	11.80	8.80	.....	.....	14.10	20.00
Arkansas	12.4	13.0	9.1	9.8	27	29	18.00	17.10	18.00	10.60	2.80	.....	17.60	19.50
Montana	17.4	19.0	12.2	13.4	46	46	11.00	10.00	9.60	8.80	.....	.....	.....	.....
Wyoming	15.1	17.0	8.9	11.1	36	40	9.00	7.70	7.00	10.50	.....	.....	.....	.....
Colorado	14.2	15.0	10.4	12.0	33	37	11.70	.....	7.00	9.50	.....	.....	.....	.....
New Mexico	13.7	14.5	13.0	12.4	34	38	13.00	.....	10.40	10.30	.....	.....	.....	.....
Arizona	19.3	20.8	17.9	15.5	49	54	.....	.....	.....	.....	.....	.....	15.00	.....
Utah	16.4	16.3	12.8	11.0	34	38	9.00	7.00	6.80	6.00	.....	.....	.....	.....
Nevada	26.0	23.0	24.0	20.0	49	59	.....	.....	.....	.....	.....	.....	.....	.....
Idaho	15.8	16.5	11.4	11.1	41	39	10.60	8.10	7.00	7.00	.....	.....	.....	.....
Washington	17.9	20.0	11.3	12.5	42	40	12.70	10.20	10.10	.....	.....	.....	.....	.....
Oregon	17.3	18.5	12.4	12.4	42	43	10.00	8.50	7.00	7.00	.....	.....	.....	.....
California	20.5	20.5	15.4	15.5	41	46	9.00	.....	8.50	5.50	.....	.....	.....	.....
U. S.	14.5	15.5	10.7	11.3	31.9	32.9	13.69	12.76	9.05	7.37	2.24	1.72	17.73	23.48

TABLE 17.—*Prices paid to producers of farm products, by States*—Continued.

State.	December 15.															
	Apples, per bushel.		Pears, per bushel.		Grapes, per pound.		Walnuts, black, per bushel.		Hickory nuts, per bushel.		Peanuts, per pound.		Pecans, per bushel, 1914.	Chestnuts, per bushel, 1914.	Hops, per pound.	
	1914	1913	1914	1913	1914	1913	1914	1913	1914	1913	1914	1913			1914	1913
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*			*Cts.*	*Cts.*
Maine	55	99														
New Hampshire	54	110														
Vermont	65	125														
Massachusetts	70	143														
Rhode Island	70	130								225						
Connecticut	60	97					125		225	240						
New York	50	97	80	82	4.0		200	90	240	225				$2.75	20	48
New Jersey	60	100	80	70			97	90	300	200				2.00		
Pennsylvania	53	93	70	117			83	80	200	200				3.70		
Delaware	65	125	38	40			68	70	55					3.50		
Maryland	47	100	75				75		58					4.50		
Virginia	50	93	85	126			60	50	125	50	3.3	4.5		2.30		
West Virginia	55	135		145			70	60	120	150				2.50		
North Carolina	50	100	100	125			75	75	95	80	3.8	4.0		1.80		
South Carolina	90	150	100	200			85	95	90	85	4.8	5.0	$6.20			
Georgia	80	105	110	108			71	85	61	85	5.0	5.6	5.10	2.50		
Florida				125				120			4.5	5.1	4.10			
Ohio	65	115	75	104	3.0		65	70	160	140				2.60		
Indiana	75	95	80	80	4.8		62	67	125	130				2.60		
Illinois	90	105	92	87	4.1		65	70	115	125			4.00			
Michigan	55	85	74	75	3.5	5.0	56	55	130	135						
Wisconsin	92	100		125			85	85	150	130						
Minnesota	85	120				8.0	100	105	150	175						
Iowa	110	120					96	95	150	150						
Missouri	78	100	100	125			55	50	95	100		5.5	4.00			
North Dakota	100															
South Dakota	125	150		150												
Nebraska	100	110		185			100	92								
Kansas	100	115	125	185	5.0		82	95	150	160			3.40			
Kentucky	87	95	99	100			55	60	105	110			3.55	1.95		
Tennessee	80	107	90	140			55	50	94	100	3.9	5.0	3.80	1.50		
Alabama	88	115	90	120			73	93	82	130	5.0	4.7	5.00	2.60		
Mississippi	100	125	100	140			88	88	86	80	4.0	4.6	4.85			
Louisiana								47			4.0	3.9				
Texas	115	135	88	110	10.0	8.5	80	95	65	70	4.7	5.6	3.45			
Oklahoma	100	130		160			90	95	100	100	4.7	5.3	3.25			
Arkansas	90	110	140	110			65	75	75	75	4.8	5.5	3.10			
Montana	80	160														
Wyoming	140															
Colorado	65	110	88	150												
New Mexico	95	125	150								7.0	7.0				
Arizona	180	210									10.0					
Utah	65	90	85	115												
Nevada	130	125														
Idaho	80	100	88	150												
Washington	65	90	80	95	2.2										10	
Oregon	85	90	85	125											11	21
California	80	130	85		2.0	2.8									10	
United States	66.6	103.6	82.5	97.9	2.3	2.9	82.4	71.8	117.8	130.2	4.3	4.8	3.72	2.28	13.2	29.4

TABLE 18.—*Prices paid to producers of farm products, by States*—Continued.

State.	December 15.																	
	Beans, per bushel.		Cabbages, per 100 pounds.		Onions, per bushel.		Sweet potatoes, per bushel.		Turnips, per bushel.		Broom corn, per ton.		Pop corn, per bushel.		Honey (comb) per pound.		Honey (extract), per pound.	
	1914	1913	1914	1913	1914	1913	1914	1913	1914	1913	1914	1913	1914	1913	1914	1913	1914	1913
			Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*			*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Me.	$3.10	$2.74	95	130	85	105	.....	.....	50	45	.....	.....	.....	271	20	20	.....	21
N. H.	3.00	2.75	115	165	100	120	.....	.....	51	55	.....	.....	218	233	20	19	22	22
Vt.	2.90	2.60	150	175	78	110	.....	.....	41	54	.....	.....	177	285	19	18	20	20
Mass.	2.71	3.50	105	140	67	120	.....	.....	50	50	.....	.....	208	350	19	18	15	.....
R. I.	.....	2.50	88	130	70	105	.....	.....	48	53	.....	.....	190	205	.....	22	.....	22
Conn.	2.90	2.55	115	160	71	110	.....	.....	45	45	.....	.....	150	200	19	18	14	14
N. Y.	2.70	2.39	48	115	71	98	.....	.....	40	40	.....	.....	146	243	15	14	14	11
N. J.	2.85	2.38	74	165	80	97	97	70	50	39	.....	.....	.....	200	16	18	16	19
Pa.	2.60	2.40	150	165	85	100	110	115	47	48	.....	.....	99	120	15	16	11	9
Del.	2.60	2.80	168	195	100	120	92	58	35	30	.....	.....	92	100	13	15	17	.....
Md.	2.90	2.10	125	250	92	80	100	50	42	25	.....	.....	.....	.....	18	15	19	.....
Va.	2.75	2.59	190	198	95	98	84	75	41	41	.....	.....	104	135	13	14	15	14
W. Va.	2.80	2.75	190	185	120	110	100	120	50	55	.....	.....	114	165	18	19	14	18
N. C.	2.47	2.35	150	205	93	91	70	67	40	46	.....	.....	133	100	14	14	13	14
S. C.	2.50	3.43	200	260	120	135	76	74	62	64	.....	.....	150	160	12	13	15	15
Ga.	2.25	2.26	170	230	105	120	67	74	60	80	.....	.....	132	152	12	12	12	12
Fla.	3.50	2.70	260	270	150	169	83	77	.....	72	.....	.....	.....	.....	12	12	11	.....
Ohio.	2.75	2.33	140	200	80	111	110	110	45	53	.....	.....	149	160	16	17	13	13
Ind.	2.62	2.47	150	210	80	103	95	105	39	52	.....	.....	154	165	17	17	15	15
Ill.	2.70	2.43	150	210	105	126	100	110	39	55	$85	$113	180	150	16	16	14	12
Mich.	2.18	1.75	90	130	55	96	.....	.....	33	32	.....	.....	89	105	14	15	10	10
Wis.	2.45	2.04	115	125	80	108	.....	.....	35	40	.....	.....	155	210	14	15	11	10
Minn.	2.30	2.11	200	220	98	95	.....	.....	47	45	.....	.....	140	140	15	14	13	12
Iowa.	2.83	2.55	200	260	110	110	160	160	52	60	.....	.....	162	140	16	15	13	13
Mo.	2.80	2.75	200	255	125	130	110	120	40	51	.....	95	162	160	15	16	13	12
N. Dak	2.80	2.79	295	350	150	170	.....	.....	55	51	.....	.....	232	205	16	.....	10	.....
S. Dak	2.85	2.85	240	315	130	155	.....	.....	75	75	.....	.....	156	215	15	15	15	16
Nebr.	2.80	2.90	200	250	105	144	125	200	48	56	.....	.....	159	190	16	16	12	12
Kans.	3.00	2.70	180	230	115	150	110	137	56	60	50	82	160	225	15	16	12	12
Ky.	2.50	2.50	170	205	110	100	85	96	35	50	.....	.....	125	100	15	14	13	12
Tenn.	2.40	2.60	200	230	97	100	80	93	39	50	.....	.....	132	150	14	14	15	15
Ala.	2.80	2.10	190	270	120	132	69	70	53	70	.....	.....	150	185	11	11	12	12
Miss.	.....	1.83	215	260	120	138	59	62	75	74	.....	.....	200	200	11	12	13	11
La.	.....	.....	.....	280	.....	120	52	60	70	80	.....	.....	125	.....	10	12	10	13
Tex.	2.90	3.36	225	297	140	143	87	98	75	89	68	82	210	215	11	12	10	10
Okla.	2.75	2.70	225	270	150	150	96	105	51	60	55	90	220	210	14	17	12	13
Ark.	3.30	2.75	260	300	115	130	81	85	45	55	.....	.....	150	135	12	12	13	12
Mont.	2.85	3.30	135	185	100	140	.....	.....	60	70	.....	.....	280	.....	13	12	9	11
Wyo.	3.20	3.15	180	235	165	170	.....	.....	85	75	.....	.....	220	.....	13	13	10	11
Colo.	2.00	2.40	85	155	80	130	.....	.....	44	55	.....	.....	263	215	12	11	9	9
N. Mex	2.25	2.40	200	210	150	150	125	125	80	95	40	70	310	.....	11	12	11	10
Ariz.	2.90	2.80	260	285	170	180	150	165	110	110	.....	.....	.....	.....	13	.....	10	7
Utah.	2.85	2.75	150	200	80	130	.....	.....	48	75	.....	.....	.....	.....	11	11	7	7
Nev.	3.00	3.00	210	200	125	118	165	140	110	60	.....	.....	.....	.....	13	11	.....	8
Idaho.	2.65	2.60	175	180	100	130	.....	.....	75	50	.....	.....	240	240	11	12	8	10
Wash.	3.60	3.00	130	150	75	115	.....	.....	49	55	.....	.....	.....	.....	13	14	10	9
Oreg.	3.10	3.00	150	150	100	120	.....	.....	60	55	.....	.....	.....	.....	12	12	.....	13
Cal.	2.60	2.60	150	175	85	120	100	150	55	100	.....	.....	.....	.....	12	10	7	7
U. S.	2.40	2.12	125.9	174.6	92.3	114.9	74.9	75.8	48.4	55.1	58.21	92.32	160.5	165.9	13.6	14.0	11.2	11.6

TABLE 19.—*Prices paid to producers of farm products, by States*—Continued.

State.	Prices paid to producers, Dec. 15.						Prices paid by producers, Dec. 15.									
	Clover seed, per bushel.		Timothy seed, per bushel.		Alfalfa seed, per bushel.		Clover seed, per bushel.		Timothy seed, per bushel.		Alfalfa seed, per bushel.		Bran, per ton.		Cotton seed meal, per ton.	
	1914	1913	1914	1913	1914	1913	1914	1913	1914	1913	1914	1913	1914	1913	1914	1913
Me.	.....	.....	.....	.....	.....	.....	$11.50	$12.00	$3.30	$3.25	.....	.....	$29.90	$28.83	$33.20	$35.30
N. H.	.....	.....	.....	.....	.....	.....	11.20	12.00	3.30	3.50	.....	.....	30.00	28.30	33.00	35.50
Vt.	.....	.....	.....	$3.25	.....	.....	11.40	10.50	3.50	3.40	.....	.....	27.80	27.30	31.50	34.70
Mass.	.....	.....	.....	.....	.....	.....	13.40	17.50	3.75	3.25	.....	.....	29.00	28.00	33.00	34.00
R. I.	.....	.....	.....	.....	.....	.....	13.20	14.40	3.20	3.00	.....	.....	28.80	27.60	32.80	35.50
Conn.	.....	.....	.....	3.00	.....	.....	12.00	11.00	3.40	3.15	.....	.....	28.50	27.30	31.40	34.10
N. Y.	$11.00	$9.00	$3.30	2.71	.....	.....	11.20	10.40	3.40	3.22	$9.50	$10.25	28.10	26.80	33.00	34.40
N. J.	.....	.....	.....	.....	.....	.....	10.80	10.10	3.25	3.00	10.50	8.75	29.50	28.30	34.20	35.50
Pa.	8.30	8.20	2.50	2.48	.....	.....	10.50	9.80	3.20	2.85	10.20	10.56	28.20	26.80	33.00	34.00
Del.	.....	.....	3.30	.....	.....	.....	9.50	.....	4.00	.....	9.75	.....	31.50	28.20	34.00	33.30
Md.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26.20	26.50	30.50	30.00
Va.	9.70	9.60	3.00	2.80	$9.17	$9.00	10.50	9.80	3.25	3.10	9.60	9.00	28.80	28.40	30.00	33.30
W. Va.	10.50	10.00	3.20	2.80	.....	.....	10.80	10.40	3.50	3.00	11.00	9.50	30.80	29.00	33.50	34.00
N. C.	.....	.....	.....	3.00	.....	.....	10.30	10.90	3.00	3.50	.....	8.40	31.30	31.00	26.70	32.40
S. C.	.....	.....	.....	.....	.....	.....	.....	8.00	.....	.....	.....	8.80	30.00	33.30	24.20	30.80
Ga.	.....	.....	.....	.....	.....	.....	.....	11.75	.....	.....	.....	10.70	30.70	31.80	25.00	30.40
Fla.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31.00	32.50	28.00	33.50
Ohio.	8.00	7.65	2.50	2.27	8.40	8.90	9.00	8.75	2.95	2.81	9.50	9.60	28.00	27.30	31.50	34.50
Ind.	8.20	7.50	2.60	2.50	8.00	8.10	9.20	8.40	3.15	3.00	9.20	9.00	27.40	25.80	30.80	33.30
Ill.	8.75	7.90	2.70	2.50	9.00	8.90	9.70	8.90	3.20	2.85	10.50	9.75	24.80	25.00	29.70	31.70
Mich.	7.95	7.70	2.40	2.30	8.20	8.20	9.30	9.15	3.15	2.90	9.60	9.50	27.60	26.70	32.70	34.40
Wis.	7.25	7.40	2.25	2.20	8.00	7.30	8.50	8.25	2.75	2.50	9.60	8.90	24.50	25.30	32.80	31.90
Minn.	7.00	7.20	2.10	2.00	.....	.....	8.60	8.50	2.50	2.50	8.75	10.00	24.10	22.60	29.50	32.00
Iowa.	8.10	7.50	2.10	2.00	.....	6.00	10.00	8.20	2.40	2.20	9.20	7.75	25.20	24.20	31.10	32.40
Mo.	9.10	8.00	2.90	2.50	9.00	9.00	10.50	9.70	3.40	3.10	10.40	10.00	24.80	25.60	28.30	31.50
N. Dak.	.....	.....	2.50	.....	.....	.....	12.00	.....	3.50	2.60	14.00	12.60	23.10	22.00	30.00	28.30
S. Dak.	7.00	12.25	1.90	.....	8.50	10.10	10.00	.....	2.50	.....	11.00	.....	24.40	22.20	33.50	32.00
Nebr.	.....	9.30	.....	3.00	7.60	6.45	.....	9.50	.....	3.40	7.80	6.80	23.60	23.15	30.50	33.50
Kans.	8.50	7.65	3.00	2.20	6.90	5.50	10.00	9.00	3.20	2.60	7.50	5.90	22.70	23.30	27.60	32.85
Ky.	9.10	8.60	3.00	2.85	.....	9.15	10.40	9.70	3.10	3.00	9.60	9.55	27.40	28.80	28.90	32.00
Tenn.	10.40	8.25	3.10	2.88	.....	.....	11.50	10.00	3.20	2.90	10.50	10.00	28.40	29.60	28.60	31.80
Ala.	.....	.....	.....	.....	.....	.....	.....	9.50	.....	.....	12.50	.....	30.10	31.20	26.30	31.20
Miss.	.....	.....	.....	.....	.....	.....	11.00	.....	.....	.....	10.00	.....	30.50	30.00	26.60	30.70
La.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28.00	26.00	25.90	29.00
Tex.	.....	.....	.....	.....	7.40	7.35	.....	.....	.....	.....	8.40	11.50	28.10	29.00	26.30	31.70
Okla.	.....	.....	.....	.....	7.60	5.60	.....	.....	.....	.....	8.50	.....	24.60	26.25	25.80	31.50
Ark.	.....	.....	.....	.....	.....	.....	11.40	.....	3.00	3.30	9.80	11.00	27.30	27.50	26.70	30.00
Mont.	7.90	.....	1.90	.....	8.00	7.50	8.70	.....	1.90	.....	10.00	11.00	25.70	23.30	31.00	.....
Wyo.	.....	.....	.....	.....	6.55	7.70	12.00	.....	2.70	.....	8.00	9.90	25.40	24.75	.....	.....
Colo.	.....	.....	.....	.....	6.90	6.80	.....	.....	.....	.....	.....	8.90	25.70	26.10	29.90	34.25
N. Mex.	.....	.....	.....	.....	6.90	.....	.....	.....	.....	.....	.....	7.40	31.30	32.00	31.40	37.00
Ariz.	.....	.....	.....	.....	9.00	6.80	.....	.....	.....	.....	15.00	.....	38.30	37.30	40.00	40.00
Utah.	.....	.....	3.00	.....	7.00	6.00	12.40	.....	4.00	.....	7.45	7.50	24.00	20.60	.....	.....
Nev.	.....	.....	.....	.....	8.40	.....	.....	.....	.....	.....	9.10	.....	33.80	29.50	.....	.....
Idaho.	9.00	7.40	1.80	1.90	8.00	7.15	10.00	9.75	2.40	2.50	9.40	8.60	23.70	22.30	46.70	.....
Wash.	.....	.....	.....	.....	.....	.....	12.30	11.00	3.60	3.20	11.60	10.80	25.90	24.00	37.20	42.30
Oreg.	.....	.....	.....	.....	8.10	6.25	.....	.....	.....	.....	8.10	.....	25.60	23.75	36.00	38.50
Cal.	.....	.....	.....	.....	9.00	8.80	.....	.....	.....	.....	11.00	.....	30.20	29.80	.....	.....
U. S.	8.12	7.70	2.18	2.10	7.57	6.60	10.04	9.43	3.05	2.84	8.81	7.25	26.72	26.43	29.04	32.36

TABLE 20.—*Averages for the United States of prices paid to producers of farm products.*

Product.	Dec. 15—					Jan. 15—		Nov. 15—		
	1914	1913	1912	1911	1910	1914	1913	1914	1913	1912
Hogs.....per 100 lbs..	$6.67	$7.16	$6.89	$5.72	$7.16	$7.45	$6.77	$7.00	$7.33	$7.05
Beef cattle.....do....	6.01	5.96	5.33	4.37	4.45	6.04	5.40	6.02	5.99	5.22
Veal calves.....do....	7.61	7.74	6.88	5.98	6.38	7.89	7.06	7.74	7.70	6.77
Sheep.....do....	4.95	4.46	4.21	3.71	4.54	4.67	4.35	4.78	4.27	4.05
Lambs.....do....	6.33	5.85	5.70	4.93	5.60	6.16	6.03	6.14	5.64	5.37
Milch cows.....per head..	58.23	57.19	48.62	42.72	43.41	57.99	49.51	58.77	57.71	47.38
Horses.....do....	130.00	135.00	139.00	134.00	141.00	137.00	140.00	130.00	136.00	139.00
Turkeys.....per lb..	.145	.155	.148	.....	.....	.155	.149	.141	.152	.144
Chickens.....do....	.107	.113	.106	.....	.....	.115	.107	.111	.114	.108
Eggs.....per doz..	.319	.329	.298	.....	.....	.298	.241	.282	.313	.286
Honey, comb.....per lb..	.136	.140	.142	.138	.137	.136	.139	.137	.141	.138
Honey, extract.....do....	.112	.116	.120	.118	.124	.113	.122	.111	.118	.120
Wool, unwashed.....do....	.186	.161	.186	.155	.178	.157	.186	.181	.156	.186
Walnuts, black.....per bu..	.82	.72	.70	.....	.....	.77	.68	.75	.70	.65
Hickory nuts.....do....	1.18	1.30	1.12	.....	.....	1.30	1.13	1.19	1.27	1.12
Chestnuts.....do....	2.28	.....	.....	.....	.....	.....	.....	2.19	.....	.....
Pecans.....do....	3.72	.....	.....	.....	.....	.....	.....	4.01	.....	.....
Peanuts.....per lb..	.043	.048	.046	.044	.045	.047	.046	.044	.044	.047
Apples.....per bu..	.67	1.04	.73	.86	1.00	1.11	.74	.57	.94	.64
Pears.....do....	.82	.98	.93	1.11	1.22	1.13	1.08	.78	.93	.79
Beans.....do....	2.40	2.12	2.31	2.42	2.20	2.17	2.26	2.28	2.20	2.25
Beans, soy.....do....	2.24	1.72	.....	.....	.....	1.96	.....	2.15	1.57	.....
Sweet potatoes.....do....	.75	.76	.77	.79	.71	.82	.84	.72	.73	.74
Turnips.....do....	.48	.55	.49	.....	.....	.57	.50	.47	.56	.45
Onions.....do....	.92	1.15	.84	1.13	.99	1.21	.82	.84	1.15	.84
Cabbages.....per 100 lbs..	1.26	1.75	1.15	1.83	1.49	1.87	1.26	1.14	1.58	1.04
Timothy hay.....per ton..	13.69	.....	.....	.....	.....	.....	.....	13.69	.....	.....
Clover hay.....do....	12.76	.....	.....	.....	.....	.....	.....	12.70	.....	.....
Alfalfa hay.....do....	9.05	.....	.....	.....	.....	.....	.....	9.20	.....	.....
Prairie hay.....do....	7.37	.....	.....	.....	.....	.....	.....	7.49	.....	.....
Clover seed.....per bu..	8.12	7.70	9.00	10.62	7.94	7.99	9.41	8.02	7.33	9.06
Timothy seed.....do....	2.18	2.10	1.79	6.72	4.11	2.07	1.79	2.34	2.08	1.82
Alfalfa seed.....do....	7.57	6.60	7.86	.....	.....	6.55	7.66	7.29	6.36	8.23
Broom corn.....per ton..	58.00	92.00	57.00	108.00	93.00	94.00	49.00	66.00	100.00	69.00
Pop corn.....per bu..	1.60	1.66	1.57	.....	.....	1.72	1.47	1.59	1.69	1.41
Cottonseed.....per ton..	17.73	23.48	21.42	16.70	25.65	22.70	21.98	14.01	22.46	18.57
Hops.....per lb..	.132	.294	.178	.425	.146	.266	.197	.156	.260	.197
Paid by farmers:										
Clover seed.....per bu..	10.04	9.43	11.10	.....	.....	9.82	11.39	10.06	9.13	11.23
Timothy seed.....do....	3.05	2.84	2.47	.....	.....	2.90	2.51	3.11	2.87	2.67
Alfalfa seed.....do....	8.81	7.25	9.49	.....	.....	8.30	8.25	8.45	7.65	9.73
Bran.....per ton..	26.72	26.43	25.16	26.99	24.68	26.53	25.24	26.40	26.47	25.06
Cottonseed meal....do....	29.04	32.36	30.16	30.50	31.58	32.49	30.97	28.36	31.97	29.37

	Jan. 1.					Feb. 1.		Dec. 1.		
	1915	1914	1913	1912	1911	1914	1913	1914	1913	1912
Wheat.....cts. per bu..	107.8	81.0	76.2	88.0	88.6	81.6	79.9	98.6	79.9	76.0
Corn.....do....	65.8	69.6	48.9	62.2	48.2	68.3	50.6	64.4	69.1	48.7
Oats.....do....	45.0	39.1	32.2	45.1	33.2	39.3	32.4	43.8	39.2	31.9
Barley.....do....	54.3	52.2	49.9	86.4	59.8	52.4	51.4	54.3	53.7	50.5
Rye.....do....	90.2	62.5	63.8	82.7	73.3	61.7	68.9	86.5	63.4	66.3
Buckwheat.....do....	77.9	76.6	66.8	73.7	65.8	75.6	69.4	76.4	75.5	66.1
Potatoes.....do....	49.7	68.4	50.6	84.5	54.1	69.7	53.1	48.9	68.7	50.5
Flaxseed.....do....	134.8	124.2	106.2	187.1	221.1	127.8	109.3	125.6	119.9	114.7
Hay.....dols. per ton..	11.29	12.42	11.86	14.85	12.24	12.41	11.64	11.12	12.43	11.79
Butter.....cts. per lb..	28.7	29.2	28.4	28.1	27.8	27.4	27.6	28.4	29.2	28.8
Eggs.....cts. per doz..	31.6	30.7	26.8	29.5	30.4	28.4	22.8	29.7	33.0	29.7
Chickens.....cts. per lb..	11.2	11.5	10.7	9.8	10.5	11.6	10.9	11.3	11.5	10.8
Cotton.....do....	6.6	11.7	12.2	8.4	14.4	11.9	11.9	6.8	12.2	11.9

TABLE 21.—*Range of prices of agricultural products at market centers.*

Product and market.	Jan. 2, 1915.	Dec., 1914.	Nov., 1914.	Dec., 1913.	Dec., 1912.
Wheat per bushel:					
No. 2 red winter, St. Louis	$1.27½–$1.28¾	$1.12½–$1.27½	$1.08 –$1.15	$0.90 –$0.97¾	$1.00 –$1.10½
No. 2 red winter, Chicago	1.28 – 1.28½	1.13⅝– 1.28½	1.11½– 1.16¾	.93⅜– .97½	.99½– 1.11¾
No. 2 red winter, New York [1]	1.36½– 1.36½	1.24¼– 1.35¾	1.22 – 1.25¾	1.00 – 1.01½	1.05½– 1.09
Corn per bushel:					
No. 2 mixed, St. Louis	.69 – .69	.62 – .68½	.63 – .80	.65 – .82	.45 – .48½
No. 2, Chicago	.68½– .68¾	.62½– .68½	.62¾– .78½	.64 – .73½	.47 – .54
No. 2 mixed, New York [1]				.78 – .85	.54½– .58
Oats per bushel:					
No. 2, St. Louis	.49 – .50½	.46½– .50	.44½– .48¾	.30½– .41½	.33 – .34½
No. 2, Chicago	.50½– .50½	.46⅞– .49¾	.47½– .50	.37⅜– .40½	.31½– .33½
Rye per bushel: No. 2, Chicago	1.11½– 1.13	1.07½– 1.12½	.96 – 1.08	.61 – .65	.58 – .64
Baled hay per ton: No. 1 timothy, Chicago	15.00 –16.00	15.00 –16.00	15.00 –16.00	14.50 –18.00	13.00 –18.00
Hops, per pound: Choice, New York	.23 – .27	.23 – .28	.26 – .36	.45 – .48	.30 – .42
Wool per pound:					
Ohio fine unwashed, Boston	.23 – .24	.23 – .24	.23 – .24	.20 – .21	.24 – .24
Best tub washed, St. Louis	.31 – .32	.31 – .32	.31 – .32	.28 – .28	.37 – .38
Live hogs per 100 pounds: Bulk of sales, Chicago	7.20 – 7.30	6.90 – 7.50	7.25 – 8.00	7.50 – 8.00	7.00 – 7.70
Butter per pound:					
Creamery, extra, New York	.36 – .36	.33 – .36½	.33½– .36	.34 – .37½	.37 – .38
Creamery, extra, Elgin	.34 – .34	.32 – .34	.32 – .33	.32 – .35½	.34 – .35½
Eggs per dozen:					
Average best fresh, New York	.42 – .49	.41 – .62	.36 – .62	.35 – .63	.30 – .55
Average best fresh, St. Louis	.35 – .35	.27 – .35	.24½– .29	.27½– .32	.22 – .27
Cheese per pound: Colored, [2] New York	.14¼– .14½	14½– .15	.14½– .15	.15½– .16½	.17½– .17⅝

[1] F. o. b. afloat.

[2] September colored—September to April, inclusive; new colored, May to July, inclusive; colored August.

INTERNATIONAL INSTITUTE CROP REPORT.

Crops in the Northern Hemisphere in 1914, compared with 1913, as reported by the International Institute of Agriculture, were as follows: Wheat, in 20 countries, 2,741,000,000 bushels in 1914 and 3,007,000,000 in 1913; rye, in 16 countries, 1,485,000,000 and 1,545,000,000 bushels in the respective years; barley, in 19 countries, 1,188,000,000 and 1,327,000,000; oats, in 19 countries, 3,304,000,000 and 3,778,000,000; and corn (maize), in 9 countries, 3,125,000,000 bushels in 1914 and 2,882,000,000 in 1913.

The crops covered by these reports amounted altogether to 11,843,000,000 bushels in 1914 and 12,539,000,000 in 1913, showing a decrease of 696,000,000 bushels, or about 5½ per cent.

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FARMERS' BULLETIN

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Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.

THE SHEEP-KILLING DOG.

By V. O. MCWHORTER, *Animal Husbandry Division.*

INTRODUCTORY.

The continued high prices of mutton and lamb have made it desirable that more sheep be kept on the farms of the United States. The excessive area of rough pasture land, weedy lots, and grown-up fence rows affords an excellent opportunity for feeding sheep, which should be used in cleaning up and maintaining the productivity of all such lands. Compared with the United Kingdom, where there is one sheep or lamb for each 2.5 acres of the total land area, in the 37 farm States of the United States, not included in the western division, there is only one sheep or lamb for each 31.8 acres of land in farms. The British farmer handles his land on an intensive farming basis, and forage-crop pasturages have been highly developed. In that country the special advantage of this system of pasturage for sheep is generally recognized.

Forage-crop pastures not only augment intensified farming and increase the fertility of the land, but also free the sheep from many internal parasites contracted through grazing upon permanent pastures. Of such parasites stomach worms are most prevalent and disastrous with young stock. Methods of preventing infection through the use of a succession of forage-crop pastures are understood and successfully followed by many farmers. In flocks handled under such conditions lambs born in the late winter or early spring are kept free from infection and finished for the market by the latter part of June or the 1st of July, at which time market prices are generally highest. It is essential that the American farmer recognize

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the small flock of sheep, handled under forage-crop conditions, as a factor in the economic handling of high-priced farm lands.

As compared with the census of 1900, that of 1910 shows an increased valuation of 20 per cent, or approximately $19,000,000, in the total value of sheep in the United States, exclusive of the western division. Notwithstanding this marked increase in value, there was a decrease in numbers of 14 per cent, or over 3,900,000 head, for the same period of time. It seems that an industry so favored by market conditions and so well adapted to the area in question should flourish rather than decline.

DOGS THE MAIN CAUSE OF DECREASE IN THE NUMBER OF SHEEP.

Sheep-killing dogs are not only recognized as the worst enemy of eastern flockmasters at the present time, but are known to be the principal cause of so marked a decrease in the numbers of sheep kept on farms. The moral effect upon all persons who have seen sheep killed, injured, or frightened by dogs is far more destructive to the industry than the actual damage sustained. No farmer contemplating the raising of sheep is likely to venture on the enterprise while the flocks of his neighbors are continually meeting reverses through the attacks of dogs, as the ultimate financial losses following such reverses are incalculable. Dog depredations to flocks are not only disheartening and discouraging to the flockmaster, but they also break up breeding plans and render flocks restless and nonproductive. The following extract from a letter published in an eastern farm paper[1] is indicative of the fact that sheep owners are finally forced out of the business if attacks by dogs are long continued. It also expresses the general sentiment of sheep-owning farmers toward dogs.

> We have grown faint-hearted and joined the ranks of the sheepless. Only a few days ago the last of the sheep were driven off the farm. I watched those old Merino ewes and their foldy necked lambs walk down the road and out of sight and a lump came in my throat and the tears were not very far back.
>
> Now these ewes, the remnant of the flock, are gone. Because we have lost interest? No; far from it. I would walk farther to see a good Merino than any other animal. Do we think tariff changes have permanently knocked the industry into a cocked hat? No; not that. We think the future is bright, and the golden hoof will be worth as much, perhaps more, as a woolgrower as in years just past, and we are planning to have the Merino again in the barn and pasture. The one reason for present abandonment would be shouted by thousands of shepherds if the question were put—just dogs! Old stuff? Yes; but it's ever new to the sheepman of eastern Ohio, Pennsylvania, and West Virginia, and to flock owners everywhere. The man who has walked out to his pasture to find dead, torn, bleeding, crippled, and scared sheep will appreciate what I say.
>
> Reclaim [a farm in Ohio] is bounded on two sides by small towns with a dog population of 200; 1 mile away on another side is another town, 2 miles away on the remaining side still another town, both with more dogs than people. We have found our sheep

[1] National Stockman and Farmer, July 18, 1914.

dead, found them with throats cut and legs torn off, found them huddled together in the farthest corner, found them scared out on the the public highway, in our neighbor's fields, and 4 miles from home. The foreigner's dog has chased them. The neighbor's dog has chased them. Dogs of all kinds seen and unseen have had a whack at our Merinos. "Why don't you shoot them?" "Why don't you keep your sheep near the barn?" "I'd poison the whole dog tribe," and many like remarks are made by folks who don't know. You who have had experience know that it's no small task to bring the sheep to the barn at early dusk every night and to make frequent visits to the pasture by day or keep a musket strapped to your back or standing in a handy fence corner while in the field and at the head of the bed at night. It's unlawful to scatter poison, and not altogether safe. * * *

We read and write and legislate, debate and discuss, quarantine and inspect to stamp out tuberculosis in cattle. Likewise do we agitate over hog cholera and horse glanders. Our trees and plants are inspected, and we insist on investigations and regulations and the stamping out of various things. All this is good. But the dog that has

FIG. 1.—Sheep killed by dogs. Part of a flock of 192 head in Calhoun County, Mich., that were killed in one night by the attack of two dogs. Few of these sheep were bitten or maimed; they were simply run to death. (Illustration used by courtesy of the Breeder's Gazette.)

done more to ruin an industry to which many men owe all they possess goes marching on uncontrolled and uninvestigated, throttling our choicest breeding ewes, chasing the calves, rushing through the hen yard and hog lot, carrying hog cholera on his feet, carrying stomach worms and parasites internal and external, spreading rabies, tramping over flower bed or back porch, practically unrestrained, enjoying undisputed rights, and all for what? Where is the man who can tell what great or good thing the dog family has done to merit all this? Why is it that dog laws are nearer dead letters than anything else on the statute books? * * *

The dog owner always comes back like this: "My dog won't chase sheep." Oh, false or deluded man! The dog does not live with such good blood in his veins but what will develop into a sheep killer if given an opportunity. I have seen too many pairs composed of one mongrel and one pedigreed cur crossing the farm together to

have faith in dogdom. We're hoping that the sheep and wool conference at Washington will be the beginning of great things for sheep husbandry. The dog was discussed, but no remedy prescribed. It's a sorry fact that custom has so overridden the law that the dog is still on top regardless of dog laws.

THE HABITS OF THE SHEEP-KILLING DOG.

Sheep-killing dogs work both singly and in groups, but usually in twos or threes. They do not limit their attacks to the flocks of the immediate vicinity in which they are kept, but travel for miles in all directions, spreading destruction in the flocks with which they come in contact. Because their work is so often done under the cover of darkness it is almost impossible to catch them in the act of worrying the sheep, and hence they can seldom be positively identified.

The ways in which different dogs attack and destroy sheep vary greatly. Some dogs simply kill one or two sheep in a flock, while others continue the attack until all the sheep are either destroyed or crippled. In many cases where large numbers are killed they are neither bitten nor wounded, but simply chased until they die from exhaustion.

After a dog has once formed the habit of killing sheep, it seemingly becomes a mania with him, and he is seldom, if ever, broken of it. He not only destroys sheep himself, but leads other dogs to the work. No consideration should be given such dogs; if additional losses to flocks from this source are to be avoided, they should be dispatched as soon as their habits are known.

ESTIMATED ANNUAL NUMBER OF SHEEP KILLED BY DOGS.

That dogs are a real hindrance to the sheep industry is not only acclaimed by the testimony of thousands of sheep owners whose flocks have suffered through ravages by them, but is verified by figures showing a conservative estimate of the partial loss incurred by flockowners during the year 1913. These figures, given in Table I, were compiled from the reports of county treasurers of different States, giving the number of sheep killed by dogs and paid for by the several counties during the year. Not all counties or States reported these losses, as in many cases no law existed which empowered the county to pay for sheep killed; for this reason it was necessary to compute the total loss on a percentage basis.

TABLE I.—*Estimated loss of sheep in farm States incurred by dogs during 1913.*

State.	Counties.		Number of sheep in counties reporting (census, 1910).	Number of sheep paid for in 1913.	Total sheep killed in State at same ratio.
	Total number.	Number reporting.			
Illinois	102	72	809,274	1,347	1,920
Indiana	92	25	314,539	3,045	12,749
Iowa	99	76	877,039	8,026	11,429
Kentucky	120	68	793,615	4,015	6,676
Maryland	23	3	21,792	231	2,384
Massachusetts	14	11	23,037	258	381
Nebraska	93	40	112,506	45	153
New Hampshire	10	2	8,110	56	290
New York	62	10	180,261	298	1,446
Ohio	88	51	2,123,324	9,619	15,561
Pennsylvania	67	43	501,131	3,125	5,396
Tennessee	96	25	272,627	100	266
Vermont	14	2	15,794	56	415
Virginia	100	56	494,799	2,873	4,355
West Virginia	55	18	289,094	1,589	4,513
Total	1,035	502	6,836,942	34,683	67,934

Twenty-one farm States not shown in the above table have 7,851,000 sheep. At the same average rate of loss these 21 States would lose annually 39,826 sheep, making a total annual loss for 36 farm States of 107,760 sheep.

While the estimated annual loss in numbers of sheep killed by dogs shown in the table is seemingly small, in that it is less than 1 per cent of the total number of sheep in the farm States, it should be remembered that a 1 per cent loss on a business that is being conducted on a 5 or 6 per cent profit basis is serious and clearly cuts the average profits of all engaged in the industry by one-fifth or one-sixth of the total that should be received. But the actual loss incurred is undoubtedly far greater than is here given, as this partial loss is estimated only upon sheep reported as killed and paid for by counties; it is known that there are many killed which are not reported. Then, too, this estimate does not take into consideration the retardation in the development of the industry suffered through prospective sheep men being kept out of it on account of the dog problem. As has been previously stated, the ultimate losses from sources of this nature can not be estimated.

THE POSSIBLE INCREASE IN NUMBER OF SHEEP.

Through a summary of the replies received from crop correspondents in the 36 farm States regarding sheep, it is estimated that the present number of sheep in these States can be increased by 150 per cent without displacing other live stock on farms. This summary, given in detail in Table II, also shows that sheep raising is considered profitable by a majority of the correspondents in most of the States and that dogs are the main barrier to keeping them.

TABLE II.—*Summary of replies from crop correspondents showing estimated possible increase in number of sheep on farms without displacing other stock and causes preventing such increase.*

State.	Is sheep raising profitable?		Average estimated possible increase in number of sheep.	Causes preventing increase.	
	Yes.	No.		Dogs.	Other causes.
			Per cent.		
Alabama	7	23	100.3	15	3
Arkansas	25	17	117.2	15	3
Connecticut	3	2	377.0	3	2
Delaware	2	1	80.0	2	1
Florida	14	5	192.7	8	1
Georgia	22	41	128.2	36	9
Illinois	43	28	90.3	17	23
Indiana	42	21	77.6	28	22
Iowa	47	11	125.4	12	22
Kansas	35	22	196.0	6	20
Kentucky	76	21	73.9	49	7
Louisiana	19	11	175.0	20	.....
Maine	8	6	150.0	10	5
Maryland	11	3	57.3	7	5
Massachusetts	3	6	125.0	5	2
Michigan	35	15	122.4	8	18
Minnesota	32	20	129.2	5	21
Mississippi	31	22	118.6	30	4
Missouri	62	15	141.4	30	23
Nebraska	20	15	246.8	4	13
New Hampshire	3	.....	357.0	4	1
New Jersey	3	7	175.0	3	2
New York	27	16	98.8	17	16
North Carolina	27	35	116.0	28	7
North Dakota	22	8	201.9	.....	10
Ohio	30	39	39.9	29	38
Oklahoma	10	14	285.9	7	.....
Pennsylvania	16	16	110.7	14	17
Rhode Island	2	.....	270.0	1	.....
South Carolina	3	22	208.1	11	1
South Dakota	29	5	111.5	3	12
Tennessee	50	13	156.5	35	5
Vermont	4	5	180.0	5	3
Virginia	63	16	127.3	39	17
West Virginia	35	5	88.7	22	9
Wisconsin	26	18	80.5	3	21
Total	887	524	150.8	531	363

An increase of 150 per cent in the sheep of the States not included in the western division would increase the total number of sheep in this country by approximately 33,681,000 head. As computed from the average farm price per head of sheep in the sections considered, for the year 1914, such an increase in number would bring about a corresponding increase in value of $144,267,000. It is believed by some who have made a study of the question that an increase of even 500 per cent need not seriously interfere with the keeping of other live stock now on farms.

The desirability of a maximum increase in the number of sheep is generally admitted. Probably the most logical method of bringing about such a condition would be through assuring the sheepman that his flock would be protected from dogs. This problem of protection, though seemingly great, should not be insurmountable.

HOW DOG LOVERS CAN AID.

Owing to his many acts of faithfulness and devotion, the dog rightfully holds a strong place in the minds and affections of men. This fact must be reckoned with in any attempt to ameliorate the injury done by the animals having the bad characters of the dog family. It sometimes happens that the dog most highly esteemed is also one that kills and worries the most sheep and is most cunning in obscuring the evidences of his clandestine prowlings. Because of the economic loss occasioned by sheep-killing dogs, and because of such dogs bringing the whole of their kind into bad repute, it is necessary that the true admirers and friends of this animal should help to further any steps likely to result in the limitation of the activity of these discrediting members of a noble race. One of the most practical methods of accomplishing this result seems to be to place upon dogs such a tax as will reduce the number of superfluous dogs and result in fewer dogs being kept by persons who can not or will not give them the attention necessary to prevent the formation of habits and associations that lead to sheep killing.

PRESENT DOG LAWS INEFFECTIVE.

With few exceptions the present State dog laws are ineffective and fail in their purpose either to protect the flocks or to compensate the owners for sheep when killed. It is very true that in some instances State laws are adequate and would afford protection if enforced; but in the past it has been almost if not wholly impossible to enforce them.

The following general discussion of those phases in the present dog laws of the farm States which should aid in the solution of the dog problem as related to the sheep industry will suffice to give an idea of the text of such laws and to show the general disregard in which they are held.

DISCUSSION OF STATE DOG LAWS AFFECTING FARM SHEEP.

LEVYING AND COLLECTION OF DOG TAXES.

Few of the States levy dog taxes directly through their legislatures. Usually counties and incorporated villages or cities are empowered to tax dogs at their discretion. Consequently the annual tax now levied varies not only in different States but in different sections of the same State, the amount running from 50 cents to $5.15 per capita. In most cases unspayed females carry heavier taxes than either males or spayed females. Individuals keeping more than one dog are generally required to pay a tax above the regular amount for each additional dog, except in cases where kennel licenses are granted. These latter licenses provide for taxes of from $25 to $50, according to the number of dogs in the kennel.

Apparently there is no general method being used by most of the States in collecting dog taxes. As this is a vital point in the enforcement of dog laws, it is important that the best method of procedure should be worked out and then used by all of the States. Seemingly those States most successful in collecting dog taxes in the past have been those assessing dogs along with other property and then collecing the tax as a personal one. Even through this system many dogs are not listed with the assessor, and thus taxation is avoided by their owners. Another method of collecting taxes imposed consists in having dog owners present their dogs to stipulated officials for registry and taxation. The success of the practical application of this system is dependent upon the attitude of the public toward the enforcement of dog laws.

IDENTIFICATION OF LICENSED DOGS.

It is not required by all of the States that licensed dogs be identified. In those requiring it they are usually identified upon the registry books of the licensing office by a statement of the breed, sex, and age, and a description giving color markings, or brands, of individual dogs. To the public they are identified by a collar bearing a metal tag upon which is stamped the register number, date, and place of issue of licenses, and in some cases name and address of owner. A few of the States furnish such collars and tags to dog owners when the dog tax is paid. This policy is to be commended and should be more generally adopted, as it insures uniform marking for all dogs licensed.

DEALING WITH SHEEP-KILLING DOGS.

With few exceptions the laws empower anyone to kill dogs caught in the act of killing, chasing, or worrying sheep. Other conditions under which some of the States permit them to be killed by anyone are as follows:

1. When found at large unattended and without a collar bearing register number.
2. When found at large, after having been proved to be sheep killers.
3. When found at large and unattended, between sunset and sunrise, on a farm where sheep are kept.

In many of the States it is a misdemeanor to keep dogs after they are known to be sheep killers, and persons so doing render themselves liable to fine or imprisonment. Such dogs must either be disposed of or killed, and if their owners refuse the dogs may be ordered killed by an official.

At the 1914 session of the Virginia State legislature, supervisors of the different counties of that State were empowered to decree that the dogs of their particular county should not run at large if, in their opinion, such liberty would be detrimental to the best interest of the community. Should such action be generally taken it will become a

misdemeanor for the owner of a dog to allow the same to leave his premises unattended, and for dogs taxed by incorporated villages or cities to leave the city limits under like conditions. If this law is applied and enforced the farm sheep industry can suffer no damage from dogs, and consequently losses from that source will be eliminated. It will be well to watch the effect of this law upon the future development of the sheep industry in the State of Virginia.

SOURCES OF COMPENSATION TO SHEEP OWNERS FOR SHEEP KILLED BY DOGS.

In 19 of the 36 farm States sheep owners are paid directly by the State, to the extent that the dog-tax funds permit, for the appraised value of sheep killed by dogs; but in 2 of the 36 such damages are allowed only in cases where owners of dogs doing damage can not be determined, or when damages can not be collected from owners when known. Of the 15 remaining States 2 offer no recourse whatever to the sheepman for collecting damages incurred by dog depredations, while the others hold dog owners responsible for damages, provided flockmasters can establish proof of dog ownership.

While to those not familiar with the workings of these laws it may seem that they assure protection to owners of farm sheep, to those who have studied them in their practical application it is known they do not fulfill the purpose for which they were enacted. Owing to the fact that dogs are seldom caught in the act of killing sheep, it is very difficult to determine their owners, and hence to hold the owners accountable for damage done, provided they are able to pay the same, which very often they are not. Even in those States where damages are paid directly from dog-tax funds, such funds are frequently insufficient to allow full reimbursement for the appraised value of the sheep, and only pro-rata payments can be made. If States will take measures to increase such funds sufficiently to pay for all damages caused to flocks by dogs, and will allow full value for pedigreed stock destroyed, this method of reimbursement should prove most satisfactory and fair to sheep owners.

UNIFORM STATE DOG LAWS DESIRABLE.

Adequate methods of controlling losses to flocks by dogs are yet to be determined. It has been suggested by some that the dogs should be taxed out of existence, but it is not believed that a prohibitive tax is feasible or that the elimination of all dogs is desirable.

However, the first object of a law of this kind should be to protect farm flocks from damage by dogs rather than to make compensation after loss has been sustained. Well-enforced taxing provisions of State laws constitute the best means for restricting the number of dogs and consequent danger to sheep.

It is believed that similar laws for all States, so enacted and enforced as to prevent damage to flocks by controlling and limiting the number of dogs and at the same time allow the farmer greater leeway in protecting his flocks, will go far toward encouraging sheep raising and gradually bring about a logical increase in the number of sheep. With this in view an outline for a suggested dog law, combining parts of various State laws with some added features calculated to give the sheep owner the benefit in cases where proof of facts is difficult, has been prepared and is here presented. It is understood of course, that this is not a syllabus of a complete dog law that will fit conditions in all States; it is only hoped that it may contain suggestions that will be helpful in the preparation of future State dog laws.

OUTLINE FOR A SUGGESTED STATE DOG LAW.

TAXATION OF DOGS.

1. State to license and tax all dogs 6 months of age or over which are not licensed and taxed by cities or incorporated villages.
2. All licensed dogs to be taxed as follows:

One male	$1.50
Each additional male	3.00
One female	3.00
Each additional female	5.00

Kennel licenses to be issued with restrictions. (Suggestions for such licenses may be obtained from the present kennel license law of the State of Connecticut.)

3. Counties or townships should be empowered to levy additional taxes on dogs should it be deemed necessary.

ISSUING LICENSE, PAYMENT OF TAX, AND IDENTIFICATION OF DOGS.

1. All dogs over 6 months of age to be reported by owner to proper county official for licensing. Owners shall also be responsible for relicensing dogs at end of each year.
2. All taxes to be paid by owner to proper county official at time of licensing.
3. All dogs to wear collar showing owner's name and to which is attached a metal tag bearing license number, date, and place of issue of license. Tags to be furnished by county official issuing license.

DEALING WITH STRAY OR SHEEP-KILLING DOGS.

1. A dog may be killed by anyone—
   (*a*) When caught chasing or killing sheep.
   (*b*) When caught off the owner's premises, unattended and on a farm where sheep are kept.
   (*c*) When caught off the owner's premises, unattended and without a tag bearing license number.
2. A reward of $15 to be offered by the proper county official to any one identifying a sheep-killing dog. (Money for payment or reward to be taken from funds accumulating from dog taxes.)
3. Dogs must be ordered killed by the authorized official when proved to be sheep killers.
4. Sheep owners to be allowed to lay dog poison on their farms by giving public notice of the fact.

COMPENSATION TO SHEEP OWNER FOR SHEEP DAMAGED OR KILLED.

1. Authorized county officials to pay owner of sheep damaged or killed the full value of damage done, from the funds accumulating from dog taxes. Should such funds be insufficient to pay all damages in full, a provision to be made making other funds available for this purpose. But should such funds accumulate in excess of the amount required to pay damages, a provision to be made making the same available for some public service after three years' time.

2. Counties should have power to proceed against owners of sheep-killing dogs to recover amounts paid out for damaged sheep.

LAW PROPOSED BY LIVE-STOCK BREEDERS' ASSOCIATIONS.

On December 2, 1914, a meeting of representatives of all live-stock breeders' associations was held in Chicago, to devise means of protecting sheep and other live stock from damage by dogs. As a result, a copy of a bill for submission to State legislatures was prepared. Copies of this bill are obtainable from Miss Julia M. Wade, secretary, American Shropshire Registry Association, Lafayette, Ind.

ENFORCEMENT OF LAWS ESSENTIAL.

The guaranty of the State to pay for sheep destroyed or injured by dogs will aid in keeping those now engaged in the industry from leaving it, but will hardly encourage others to enter the field. If sheep raising is to be encouraged where it has now been partially abandoned on account of the dog, it is essential that the frequency of the attacks upon flocks be reduced to a minimum. The industry must be encouraged through affording protection to the flock rather than through paying for sheep destroyed. Such protection can be afforded only through strict and rigid enforcement of dog laws enacted. Action on the part of single individuals can not bring about the desired results; entire communities must work in cooperation with county or State officials for the protection of sheep. Undoubtedly such cooperation can be fostered by the States through publishing and giving State-wide distribution to dog laws. Ignorance of such laws as they exist is often accountable for the little attention given to them.

THE USE OF DOG-PROOF FENCES TO PROTECT FLOCKS.

Flockmasters need not dispose of their flocks because of the dog menace, even as it now exists. With the more general adoption of methods of intensive farming, the grazing of sheep upon comparatively small areas of land sown to forage crops instead of upon permanent pastures in larger fields is facilitated. Such a change in pasturage reduces the fenced area to a minimum and thus makes possible the building of dog-proof fences around the smaller fields.

The Forest Service of the United States Department of Agriculture has had experience in the range States in fencing pasture for the purpose of protecting flocks from the attacks of coyotes. Forest Service

Circular 178, in which a report of these investigations is given, states that during the 3-month period through which observations were noted not a single coyote was known to enter the fenced pasture. Certainly a fence so designed as to turn a coyote would turn a dog, and there is no reason to believe the eastern farmer would not be justified in assuming that a properly constructed fence of this kind would protect his flock from dogs. The accompanying diagram illustrates a fence similar in detail to that used by the Forest Service in their western investigations; but if dogs are to be turned aside by this fence, it is absolutely essential that the bottom barbed wire be stretched flat on the surface of the ground at all points. If the ground over which the fence is to be built is uneven, proper construction can be facilitated by grading the ground before putting up the fence.

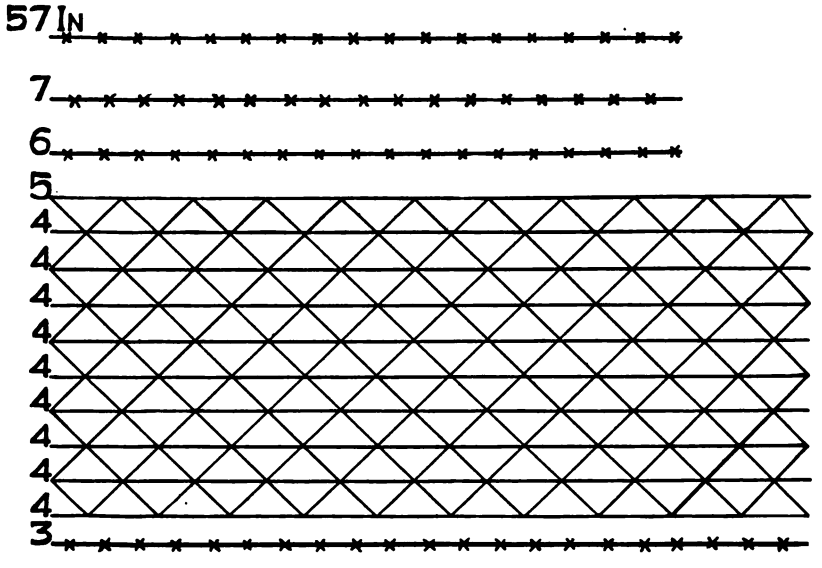

FIG. 2.—A dog-proof fence.

Small holes appearing after the wire is stretched can be filled in with dirt or other material.

Specifications for the dog-proof fence:

Posts 7½ feet in length, set 2½ feet in the ground and 16 feet apart; a barbed wire stretched flat to the surface of the ground; 3 inches higher a 36-inch woven-wire fence having a 4-inch triangular mesh; 5 inches higher a barbed wire; 6 inches higher a second barbed wire; 7 inches above this a third barbed wire. Total height, 57 inches.

FENCING OF SMALL INCLOSURES FOR PROTECTION OF SMALL FLOCKS.

Many farmers having only a few head of sheep would not incur the expense of building dog-proof fences around their sheep pastures. In such cases small lots might be thus fenced and the sheep placed in

them at nights. As dogs generally make their attacks on flocks during darkness, the sheep can be turned on the open pastures during the daytime and thus the flock can be handled with a fair degree of safety. But undoubtedly there are many farmers who would object to handling sheep in this way, as a small period of time is required each morning and each evening in driving the sheep from and to the folds. However, it should be remembered that if sheep are worth keeping they are worth caring for, and this method of protection is

FIG. 3.—A dog-proof fenced lot in which sheep may be placed at night.

worthy of consideration for flocks not otherwise protected, and in areas where dog attacks are frequent.

Figure 3 shows a dog-proof fenced inclosure suitable for protecting sheep from dogs at night. The fence used in this case is not the same as that used by the Forest Service in fencing against coyotes. It is suggested that perhaps the coyote-proof fence would be even better suited for turning dogs than the one here shown, for dogs, as well as coyotes, are very shy of barbed wire.

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FARMERS' BULLETIN

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Contribution from the Office of Experiment Stations, A. C. True, Director.

HONEY AND ITS USES IN THE HOME.

By CAROLINE L. HUNT, *Expert in Nutrition*, and HELEN W. ATWATER, *Assistant in Nutrition, Office of Experiment Stations.*

INTRODUCTION.

In the days before trade with the Tropics introduced cane sugar into temperate regions honey was by far the most common sweet substance available for human food. In very early times men discovered that the material deposited by honeybees in hollow trees and in the crevices of rocks was a valuable and agreeable food and learned to appropriate it to their own use. Such wild honey is still gathered in Palestine and in the less advanced parts of Africa, in Asia, and in South and Central America, that from Peru making an important article of export. Bee trees, which were considered a prize in pioneer times in this country, are still valued in some remote rural regions, and not infrequently people living in country or village take the comb from a colony of bees which has settled in a corner under the weatherboarding of a building or some similar place.

The naturally built combs are of course very irregular, and this fact, combined with the difficulty of driving the bees out, is likely to cause great loss of honey and to injure the colony. The idea of getting bees to build their combs in some special and convenient place of man's providing—that is, in a hive—seems to have occurred very long ago to people almost everywhere, and the custom of "keeping" bees instead of seeking out their haunts was the first step toward securing a better and more economical supply of honey. Bee-keeping is now almost universal except in regions of extreme cold and among savage tribes.

The hive, once adopted, has undergone many changes, all of them intended to direct the activities of the bee to the service of man. Up to 60 or 70 years ago the hives most commonly in use among nations of European origin were the round and slightly pointed

NOTE.—This bulletin is of interest to housekeepers throughout the country.

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ones made of tightly braided straw or willow, which are known as skeps and which have become a generally recognized symbol of industry. In these the combs are built irregularly, and since they are fastened firmly to the top and sides they can not be handled separately. There is no provision for separating the brood cells where the bees rear their young from that extra supply of honey which they instinctively store in times when the nectar flows freely and which is the only part that can be used as food for man. The destruction of the colony at the time of taking the honey was formerly a common practice.

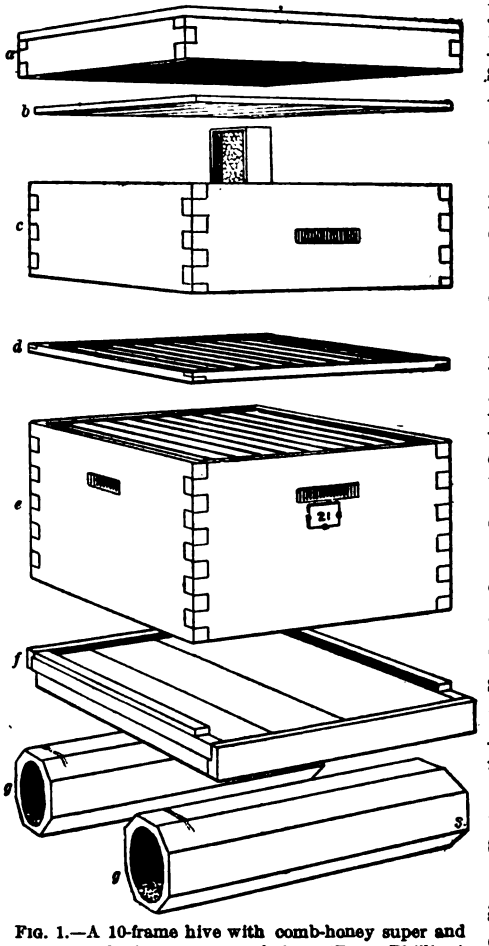

FIG. 1.—A 10-frame hive with comb-honey super and perforated zinc queen excluder. (From Phillips.) (*a*) Cover. (*b*) Inner cover. (*c*) Super. (*d*) Queen excluder. (*e*) Hive body for brood. (*f*) Bottom. (*gg*) Supports.

The hives now most commonly used in this country are of the type invented by Langstroth in 1851. They consist of rectangular wooden boxes or chests from the sides of which, at a point near the top, removable frames for the combs are suspended. One or more supers or extra parts of the hive are kept on hand, so that new ones can from time to time be placed on the part of the hive used for brood rearing, and thus the amount of honey-storing space can be enlarged when the bees are most active in gathering nectar. The modern hives are sometimes supplied with queen excluders, which permit only the worker bees, which are smaller than the queen, to pass from the lower hive body into the place reserved for the surplus honey, thus preventing the rearing of brood in the supers. There is also an arrangement by which all of the bees can be trapped, and thus kept out of the supers when the honey is to be removed. (See fig. 1.)

Not long after the introduction of Langstroth's hives gave an impetus to commercial beekeeping a centrifugal honey extractor was invented, which greatly improved the method of removing honey from the comb. Formerly honey was strained from the combs, and such honey was a rather uncertain product and often contained various kinds of refuse, such as parts of dead bees, etc., which could not be easily removed. When the modern centrifugal machines are used, the wax caps which close the cells of the combs are cut off, and the uncapped combs are put into the extractor, which throws the liquid honey out by centrifugal force and lets it run off at the bottom of the machine. Honey which has just been extracted may contain some pieces of wax capping and other impurities. Hence, extractors are usually provided with strainers which remove the larger particles as the honey passes out. The particles are lighter than honey. Honey is therefore usually allowed to stand until they rise to the top in scum, and the latter is removed before the honey is put into cans or bottles.

Because extracted honey is easily adulterated, the public was formerly rather suspicious of its purity. Recently, however, owing to pure-food legislation, to the watchfulness of the Bureau of Chemistry of the United States Department of Agriculture and State agencies charged with the carrying out of pure-food laws, and also to the efforts of honey producers, the practice of adulterating honey has become dangerous and unprofitable; confidence in the extracted article has been largely restored, and there is relatively little adulterated extracted honey on the market.

Although the greater part of the honey produced is now sold as extracted honey, there is still a good market for comb honey, and since appearance is an especially important feature in judging it, the producer takes special pains to have the combs regular in shape and attractive in color. Comb honey can not be adulterated except by processes which cost more than the retail price, and therefore the purchaser may be sure that comb honey is the product of the hive.

There are two kinds of natural honey, known as floral or normal, and honeydew or abnormal, the former being made from nectar, a sweet liquid secreted by flowers, and the latter from honeydew, a sweet substance deposited on the leaves of plants by plant lice and other insects. Unless otherwise stated, the term "honey" when used in this bulletin may be understood to refer to the kind made from nectar, or to that in which the quantity of honeydew is so small that it does not greatly affect the character of the product.

The chief materials that the worker bees bring to the hive are nectar, pollen, and propolis. They collect the pollen on the hairs on their bodies, place it in the so-called pollen baskets on their legs,

and thus carry it back to the hive to be deposited near the brood cells. This pollen is rich in nitrogenous material and is important as food for the young and developing bees (larvæ). A few grains usually find their way into the honey cells. Propolis or bee glue is obtained from the gums exuding from trees and shrubs. It is taken to the hive in the same way as pollen and is used to make the hive waterproof and sometimes to strengthen the edges of the comb. If any gets on the capping of the honey it tends to spoil the appearance of the combs; these traces of propolis are known as "travel stain."

Nectar is the material from which honey is made. The bees suck it out of the flower with their long tongues and swallow it into the honey sac where it undergoes some changes not yet well understood. It consists chiefly of sugar and water, the former constituting usually between one-fifth and two-fifths of the entire weight and the latter between three-fifths and four-fifths. With this substance are mixed small quantities of other materials, chiefly mineral matters, gums, and volatile bodies. To the latter the aroma and flavor of honey are chiefly due.

The changes by means of which nectar is transformed into the finished honey are technically known as "ripening." They take place partly in the honey sac of the bee, and partly in the cells of the comb, continuing even after the latter have been capped with wax. They consist mainly in removal of part of the water from the nectar, a task which the bees accomplish by warming the air of the hives and also by fanning the nectar in the cells, and in the change in the chemical nature of the sugars, which will be described later (see p. 5).

Wax is made in and secreted from special glands on the abdomen of the worker bee. Several pounds of honey are used in producing a pound of wax, and a high temperature must be kept up in the hive by the bees while it is being made. Because of the cost of wax secretion beekeepers usually try to arrange that the bees shall have little comb building to do except when comb honey is being produced.

FOOD VALUE OF HONEY.

Like most foods, honey, although preserving its general character, varies more or less from the average composition. The variations are of interest to the housekeeper in so far as they may affect the food value or the way in which the honey can be used to the best advantage in cookery. They may also be of decided interest to the food inspector, as departures from the usual composition may help him to detect the presence of adulterants.

So far as its food value is concerned honey may be roughly described as a sirup with a distinctive flavor and aroma made up of 4 parts sugar to 1 part water. There are several kinds of sugars present in honey, including cane sugar (sucrose), grape sugar

(dextrose), and fruit sugar (levulose); the last two together being called invert sugar. Some dextrin is also present as well as a variety of other substances in very small amounts. Included among them are nitrogenous substances (protein) which occur in quantities too minute to affect the food value of honey for man. Some of the other substances present in minute quantity, namely volatile oils, or other bodies of pronounced odor or flavor from the nectar, are valuable because they influence the flavor and aroma of the honey.

According to data gathered by the Bureau of Chemistry[1] honey, on an average, contains in round numbers per hundred parts 18 parts water, 78 parts carbohydrates (including 76 parts sugar and 2 parts dextrin), 0.2 part mineral substance, or ash, and nearly 4 parts of undetermined substances such as pollen grain, gum, bee glue, formic acid and volatile oils, and other flavor substances. These are average values and there is, of course, considerable variation in individual honeys. For instance, the proportion of water varies from about one-eighth to one-fourth of the total weight of the honey, being influenced by the moisture in the air at the time the honey is produced and the dryness of the atmosphere in which the honey is kept afterwards. Samples of honey from conspicuously dry localities (the southwestern part of the United States, for instance) and honeys made in other localities in very dry weather have a relatively low water content.

The most abundant of the mineral substances in honey are magnesia, lime, phosphoric acid, and iron. Since honey contains less than 1 part per hundred of mineral matter, it is obvious that even if eaten in large amounts it could not contribute greatly to the total mineral matter of the diet. However, it is claimed that unless care is taken in selecting foods there is a possibility that the diet may contain too little lime, and for this reason it is worth noting that honey contains this constituent. In respect to its ash content it is more comparable with maple sirup than with cane sugar from which the mineral substances originally present in the plant juices have been removed during the process of refining.

The percentage of the different sugars varies more or less, but under any circumstance the amount of cane sugar is small (some 2 parts per hundred) and less than in the nectar from which the honey is made. The proportion of dextrose (grape sugar) and levulose (fruit sugar) making up the total invert sugar varies in honey as it does in the nectar from which it is made, but this is of no importance in planning meals. However, it is of practical importance for the reason that it determines the character and appearance of the honey. Honey will granulate easily if the proportion of dextrose is large, but this is

[1] U. S. Dept. Agr., Bur. Chem. Bul. 110.

not the case if levulose predominates. For example, alfalfa honey which contains a high percentage of dextrose often forms such a solid mass of crystals that it is sold in cakes. This may be an advantage sometimes. Thus, the solid alfalfa honey can be used for such purposes as filling for layer cakes, for which liquid honey would not be so suitable because it would run out. The proportion of dextrin present in normal or nectar honey is so small that it affects neither food nor cooking values. Abnormal or honeydew honey, however, contains so much dextrin that it requires special handling in cooking. This is a matter of interest to professional bakers rather than to housekeepers, as such honey is not commonly used in the home.

Since the principal ingredient of honey is sugar, it is obvious that it should be classed with the fuel foods which supply the body with the energy it needs for the various tasks it performs rather than those whose function is to build and repair the body—that is, the "tissue formers," as they are sometimes called. If honey contained no water its energy value would be practically the same, pound for pound, as that of cane sugar. However, since about one-fifth of its total weight is water, it follows naturally that its energy value is one-fifth less than that of cane sugar, being 1,485 calories per pound.

In planning meals, particularly in hospitals, children's homes and other institutions where large quantities are required, it is often convenient to have some quick and fairly accurate method of estimating the relative value of different articles of diet which are used in similar ways. For this reason it is worth remembering that an ordinary tablespoonful of honey which weighs a trifle over an ounce will furnish the body 100 calories. The same amount of energy would be supplied by five-sixths of an ounce of sugar, by 1¼ ounces of molasses, or by a little less than an ounce of preserves (such as orange marmalade).

FLAVOR OF HONEY.

The flavor and aroma of honey depend largely upon the blossoms from which the nectar is obtained. The nectar of each kind of flower contains a distinctive combination of oils and other substances which gives the blossoms their special fragrance, and these substances are retained in the honey made from the nectar. It is practically impossible to prevent bees from visiting more than one kind of flower during a given period, and, strictly speaking, almost every kind of honey is made from a mixture of different nectars. Nevertheless, when the hives are situated near a large supply of one sort of blossom, its nectar usually predominates and its flavor and aroma can be easily recognized in the honey. It is perfectly correct, therefore, to speak of basswood honey, fruit-blossom honey, buckwheat honey, etc.

Different localities naturally produce different kinds of honey, and different kinds may be produced in the same locality at different seasons, according to the kinds of flowers which abound. Several famous European honeys, among them the choice French variety from Narbonne, owe their characteristic aromatic flavor to wild thyme and other flowers of the mint family. In orange honey from districts where orange blossoms abound the peculiar aroma and flavor of the flowers are very clearly marked. Sage and clover honeys are well-known American varieties in which the characteristics of the nectar are easily and pleasantly recognized.

Choosing between honey from different flowers is mainly a matter of taste; and taste in honey, as in many other things, seems to depend more on what one has been accustomed to than on any real superiority. For example, it sometimes happens that a person who has always used buckwheat honey with its full-bodied, rather acid flavor, imagines that a mild, light honey with less of the characteristic "comby" taste must be adulterated, whereas a person who is familiar only with some such delicate honey as white clover or alfalfa may consider buckwheat very inferior, or even fancy that it is not genuine floral honey.

The relative abundance of different flowers and consequently the flavor of the honey vary so greatly in different seasons that beekeepers can not count on a regular yield of uniform honey, and their patrons may be disappointed to find that the honey of one year is different from that of the year before. To overcome this difficulty many of the best wholesale dealers have recently adopted the practice of mixing several honeys to produce a blend. This process is like that adopted long ago in the case of teas. To blend honeys so that the mixture will be generally acceptable requires a great deal of skill, but when the consumer has found a blend which pleases him, he is more likely to be able to get honey of that flavor season after season than if he depends on unmixed honeys.

WHOLESOMENESS.

Because the chemical change effected by the bee in the sugars of the nectar is the same as that effected by digestive ferments, and the principal sugars may therefore be considered to have undergone the first step of digestion, honey is often said to contain predigested sugar, and to be more wholesome than cane sugar. There is no reason, however, to believe that the healthy human body is not equal to the task of digesting any sugar, so a special claim made for the wholesomeness of honey on this ground seems unimportant. It is generally believed that the energy from sugar is liberated for the use of the body more quickly than that from such other fuel foods as

starch and fat. Hence it is said to delay the oncoming of fatigue during great muscular exertion. For this reason some form of sweet is included in almost all army rations and is often used by persons undergoing severe physical exertion, such as mountaineers and athletes. Although no experiments have been made to test the value of honey in this respect, it seems safe to suppose that it would have the same good effect as other sweets.

Everyone knows that eating too much ordinary sugar upsets digestion. The differences in the effects of too much honey and too much cane sugar are rather complicated, but it is safe to say that eating too much of either should be avoided, even by healthy people.

For some persons suffering from serious digestive disturbance honey may be a safer form of sugar than cane sugar, but with other forms of indigestion the opposite is true; it depends upon the particular form of disturbance, and such matters should be decided by a skillful physician for each individual case. For persons of very delicate digestion the particles of wax in comb honey may cause trouble, as it is believed that the digestive processes do not have any effect on them. For normal persons, however, the wax should be as harmless as are the particles of indigestible material contained in many other wholesome foods.

Honey is sometimes said to have a mildly laxative effect, and the statement is doubtless true, as it is of many other food materials, especially those of vegetable origin. If a person had to live on a very limited number of foods, especially if he had a tendency to constipation, it might be wise to use honey rather generally in preference to other forms of sweet; but the effect of such small amounts of honey as would be used in an ordinary diet would hardly be worth taking into consideration. Bran biscuits made with honey instead of sugar (see p. 16) would owe any advantage they might have over the ordinary bran biscuit to the laxative effect of the honey.

Other medicinal qualities have been claimed for honey, particularly in older writings, and it still finds use in medicinal preparations, but no doubt more because of tradition and of the flavor and texture it imparts than for actual medicinal properties. From the standpoint of the honey industry this is a matter of little importance, for honey is regarded by the vast majority of its users as a food and not as a drug product.

Even if honey has no such specific medicinal advantages, this does not in the least lessen its general value as a wholesome, useful foodstuff, well worthy of even more extended use than it already has, not only because it is agreeable and economical in itself, but also because it introduces a pleasing variety and thus makes the diet more appetizing, and consequently more wholesome.

ECONOMY OF HONEY AS FOOD.

Whether or not honey can be economically used in the diet as a source of nourishment depends of course upon its food value and its price as compared with other food for which it may be substituted. To compare food materials in these two respects is no easy task because, besides varying in price with time and place, they may differ widely in the kind and the quantity of the nutrients which they supply. If honey is compared with cane sugar at 7 cents a pound on the basis of the energy which it provides for the body, it should sell for not more than 6 cents a pound in order to be as economical. Comparing it on the same basis with butter at 40 cents a pound, it is evident that it might sell for 17 cents a pound and be equally economical as a source of energy.

The differences between the wholesale prices of comb honey and of extracted honey are much greater than those between the retail prices. A pound of extracted honey in a jar usually sells at retail for about the same as the average section of comb honey, which has a net weight of 14 ounces. On the other hand, the wholesale price of comb honey is usually about 50 per cent higher than that of extracted honey. The reason for this is that the producer of comb honey does far more of the work of getting his product ready for the final market than does the producer of extracted honey. As the sections leave his hands so they are passed over the counter to the housewife or other retail purchaser. Extracted honey, on the contrary, is sold by the producer to the bottler, not in pound lots but in 5-gallon cans or barrels. The bottler does the work of blending, liquefying, bottling, labeling, and packing. It is possible, therefore, for the consumer to save money by buying extracted honey at wholesale and avoiding the cost of the various kinds of work which prepare it for the retail market.

Where only small quantities of honey are used, the effort to buy in the cheapest market may cost more in energy than it saves in money. Where, however, large supplies are bought, the purchaser should try to get into direct communication with the producer and take advantage of the parcels post as a means of transportation. The names of dealers in his vicinity can often be obtained from the bee-keepers' magazines, or by writing to the State inspector of apiaries. The names of State inspectors and often those of local dealers can be obtained by addressing the Bureau of Entomology of the United States Department of Agriculture.

Now that extracted honey is usually pure and of good quality, the advantage of comb honey lies chiefly in its attractiveness to the eye. Unless very great care is taken in extracting honey, some of the

volatile bodies on which its flavor depends will probably be lost. Hence it often happens that the flavor of comb honey is really slightly superior to the same kind extracted. Many persons think that the presence of the wax gives the honey a more pleasant consistency for table use. Whether these advantages are worth the extra cost each consumer must decide for himself.

Comb honey is commonly graded according to finish and color. It is described as Extra Fancy, Fancy, No. 1, or No. 2, according to the evenness with which the sections are filled, the freedom of the product from propolis or other stains, and the number of unsealed cells. It is graded according to color as white, light amber, amber, and dark. From the point of view of food value alone, finish and color are not of importance, though dark honeys are usually of stronger flavor.

In order to comply with the Federal Food and Drugs Act which applies to all goods shipped from one State to another, every section of honey and every package containing extracted honey must be marked with the net weight. In comb honey this is understood to be the weight of the comb and the honey and to exclude the weight of the wooden frame.

In choosing honey too much importance should not be attached to lightness of color, for some of the best varieties are dark; nor should granulation be thought to imply adulteration. The truth is that crystallization is more likely to occur in pure than in impure honeys, and some pure varieties, especially alfalfa honeys, granulate so easily that they are often sold to the consumer in solid form. The crystals can easily be dissolved by heating the honey, which should be done in a double boiler or other kind of water bath. If the temperature does not go beyond 160° Fahrenheit, there is little danger that either color or flavor will be affected.

Unless in a sealed package, honey should be kept in a dry place; otherwise it is likely to absorb moisture and spoil, for when dilute it will ferment or sour readily, as will any other similar sugar sirup. Heat and dryness are usually found together in the household, and ordinarily the safest places for honey are the warmest places; the least desirable is the refrigerator.

USES OF HONEY.

Honey is used both in its natural state and as an ingredient of cooked food. In this country it is more commonly used uncooked than cooked, and practically all comb honey is consumed in this way. Honey is much more commonly used in cookery in Europe than in America, though commercial bakers and confectioners in the United States use much larger quantities than many persons realize.

The simplest way of using honey is to serve it like jam or sirup with bread, breakfast cereals, boiled rice, pancakes, and other mild-

flavored foods. As ordinarily used on bread, an ounce of honey "spreads" as many slices as an ounce of jam. When it is to be used in the place of sirup some people dilute it by mixing it with hot water, which has the effect of making it not only less sweet but also easier to pour.

Honey or a mixture of honey and sugar sirup can be satisfactorily used for sweetening lemonade and other fruit drinks. Sirup of any kind is more convenient for this purpose than undissolved sugar, and when charged water is to be added it has a further advantage since it has less tendency to expel the gas. It is the custom of many housewives to keep a sirup for this purpose, particularly in hot weather, and variety can be secured by occasionally using honey.

Honey can be used in place of sugar for some kinds of preserving, and there is reason to believe that fruits cooked in it keep very well indeed. Bar-le-Duc currants, which form a very delicate and expensive article of commerce, are often made by cooking currants in honey. They are frequently served with cream cheese and crackers or other form of bread. A satisfactory substitute may be secured by serving honey and tart fruit, either cooked or uncooked, with cottage cheese and bread and butter. Three ounces of cottage cheese curd, two ounces of bread, two-thirds ounce of butter (either added to the curd or spread on the bread), two ounces of honey, and six ounces of strawberries or other watery fruit would make a reasonably well-balanced meal. Sometimes honey alone is served with cream cheese. Crisp crackers, spread with cream cheese and honey, form a good combination from the point of view of nutritive value and taste. Honey may be substituted for sugar in baking apples.

HONEY IN COOKERY.

When used in cookery honey does not always produce the same effect as corresponding quantities of sugar or molasses, and the reasons for some of the differences between them are not well understood. Careful experiments with various types of honeys and honey recipes were therefore made in the nutrition laboratory of the United States Department of Agriculture, in the hope of explaining such points. Most of the facts stated in the following paragraphs were obtained in this way, and all the recipes (pp. 15–26) were tested there.

The fact that honey consists principally of sugar and water and is slightly acid suggests that it is a suitable substitute for molasses in cookery. As a matter of fact, it can be used in the place of molasses in all forms of breads, muffins, and cakes, and makes a more delicately flavored product. It contains less acid than molasses, however, and so requires less soda when it is substituted for molasses in recipes which do not include sour milk or other acid, and the cook

must be careful about the amount of soda used. Many trials were made with different kinds of honey in this laboratory which showed that the allowance of soda to a cupful of honey very generally ranges between one-fourth and one-half of a level teaspoonful. Unless the cook is thoroughly familiar with her honey, she would do well to mix and bake a small sample of dough before she decides on the amount of soda to be put into the main portion.

When honey is to be substituted for common sugar it is desirable to know not only how it compares in sweetness, but also how much allowance must be made for the water which it contains. Assuming a cupful of good honey to measure one-half pint, it should weigh about 12 ounces. Of this, 9 to 10 ounces, roughly speaking, is sugar. A cupful of honey, therefore, corresponds to a little more than a cupful of cane sugar. Hence it is safe to estimate that a cupful of honey will sweeten a dish just about as much as a cupful of sugar. Besides the sugars, there is about one-fifth of a cupful of water in a cupful of honey. Theoretically, therefore, in making cake one should substitute honey for sugar cupful for cupful, and for each cupful of honey use one-fifth cupful less of the milk or other liquid which the recipe calls for. For practical purposes, however, it is accurate enough to consider that the water in a cupful of honey is one-fourth of a cupful. This rule was found to hold good with a large number of ordinary cake recipes which were tested in this laboratory. These facts, if kept in mind, make special honey recipes unnecessary and enable the cook with very slight calculation to modify ordinary ones so that honey can be used in place of sugar. Besides slightly changing the flavor of the cake, honey used in the place of sugar makes it keep moist longer. A honey cake made with butter will keep its quality until the butter grows rancid, and one made without butter will keep fresh for months and even improve in flavor. What is true of the cakes is also true of the dough; it can be kept almost indefinitely. Evidently, then, honey is especially useful in recipes without butter. For this reason, most of the honey cakes experimentally studied in this laboratory were made according to the following formula which is typical of Honig Kuchen, or German Christmas cake: Three-fourths cup honey, one-half cup sugar, two cups or more flour, one-fourth teaspoon powdered ginger, one-half teaspoon powdered cardamom seed, one teaspoon cinnamon, one-eighth teaspoon cloves, a speck white pepper, a pinch salt, one-fourth to one-half teaspoon soda, one tablespoon water, and two ounces blanched almonds cut in small pieces or chopped.

The directions for making the honey cakes, not only in the older cookbooks, but also in many modern bakers' manuals, are extremely elaborate; one of the purposes of the experiments made in this

laboratory was to determine how many of the suggested precautions are necessary.

Recipes usually direct that the honey be brought to the boiling point and then skimmed and cooled. This must be done with great care, for the honey is very likely to boil over. Experiments with a large variety of honeys such as are ordinarily purchased in the United States for household use, showed that nothing rises to the top during the boiling which can not be easily stirred back into the liquid. It seems likely therefore that the custom of boiling had its origin at the time when honey, or at least the grades bakers use, was much less carefully prepared than at present and contained impurities of many kinds. A cake made by stirring flour directly into cold honey was found to be in no way inferior to those made with honey which had been heated.

Some recipes found in the older cook books, particularly those of foreign origin, direct that the spices be boiled with the honey and give as a reason for this that the heating brings out their flavor and makes them "go further." The weight of this argument is obviously difficult to determine, but the work carried out in the Nutrition Laboratory gave no evidence that the short heating at the beginning is of special importance in comparison with the long heating which the materials must receive while the cake is being baked.

The older recipes almost invariably direct that the dough be kept for a certain length of time, sometimes one day, sometimes more, before the soda is added. So reliable an authority as König says that this is because, owing to the presence of bacteria, the acidity of the mixture increases with time, and that therefore more soda can be used after the dough has stood. To test this point, dough was mixed in this laboratory and analyzed by the Bureau of Chemistry; it was found to have 0.0775 per cent of acidity immediately after being mixed, and 0.1 per cent after four days' time. Another sample increased in six days from 0.108 per cent to 0.117 per cent, and during the following six days to 0.125 per cent. It seems probable, therefore, that the acid does usually increase; but even so, the question arises whether there is not in the beginning enough acid to act on soda sufficient to raise the cake. In order to determine this, two samples of dough were mixed. To No. 1 the soda was added at once and baking followed immediately. No. 2 was kept for a week, when the soda was added and the cake was baked. The second was neither lighter nor in any way superior to the first.

It is frequently stated that the dough can be more easily kneaded if it is allowed to stand several days. In order to test this point, a dough was mixed which was stiff enough to hold its shape, but which stuck to the hands and the molding board. After a week's time it

could be molded freely on an unfloured board without sticking to it. This argument for keeping the dough seems therefore to be sound.

It is sometimes said that the reason why cakes made with honey keep soft for a long time is that they absorb moisture from the air. To test this point a cake made according to the recipe already given was weighed at different intervals during 7½ months. The weight of the dough was 526 grams, the weight of the cake on the day of baking, April 17, 1913, was 499 grams after it had been removed from the pan, and at the final weighing on December 2 of the same year, it weighed 469.7 grams. The loss of weight was continuous during all this time, with the exception that in the late summer there was a slight increase in the weight, probably due to unusual dampness of the air; this was followed by a relatively great loss. On December 2, when the cake was cut, it was in good condition, and had a fine flavor and the consistency of a soft cooky. The experiment was repeated with small honey cakes, and these also showed no increase in weight before softening. While these experiments are not sufficient for definite conclusions, they indicate that the increased softness of the honey cake is not due to the absorption of water.

Icing made with honey or with part honey and part sugar according to the recipe on page 25 has the same advantage that honey cakes have. Such icing made in this laboratory was found at the end of 10 months to be soft and in as good condition as when originally made. It would, therefore, seem to be suitable for cakes that are to be kept for a long time.

In most of the recipes in foreign cookbooks "potash" (potassium bicarbonate) is recommended for use with honey to raise the dough. This is very similar in its properties to ordinary baking soda (sodium bicarbonate) and seems to have no advantage over it for this purpose. Whatever may have been the conditions in earlier times in Europe, baking soda is a common kitchen commodity in most American homes, and the potassium bicarbonate is almost unknown for household purposes. Both the potassium bicarbonate and baking soda gave much better results in the honey recipes tested than did the baking powder, and naturally, since the acid honey calls for an alkali like soda rather than a mixture of acid and alkali such as baking powder. If baking powder were used it should be in addition to soda enough to neutralize the acid of the honey, not merely as a substitute for soda, just as housekeepers sometimes neutralize sour milk or molasses with soda and then add baking powder to raise the dough.

In the countries where honey cakes have come to perfection spices are used which are somewhat uncommon in this country, and it is reasonable to suppose that long experience has taught a good com-

bination of flavors. Cardamom seed, a rather old-fashioned flavor which is still sometimes found in candies, seems to combine more satisfactorily with the flavor of honey than some of the spices which are better known in our kitchens. It is best, however, to use it in combination with other flavoring materials. The following has been found to be a good combination:

Salt, 1 part by measure.
White pepper, 1 part.
Nutmeg, 2 parts.
Cloves, 2 parts.
Ginger, 4 parts.
Cardamom, 8 parts.
Cinnamon, 16 parts.

These should be thoroughly mixed and can be made up in quantity and kept ready for use.

Aniseed and coriander seed are also often used in honey cakes in combination with other spices. The following mixture is recommended in a baker's handbook,[1] the amounts given being suitable for 10 pounds of dough:

2 ounces ground cinnamon.
½ ounce ground cloves.
2 ounces aniseed.
1 ounce finely ground coriander seed.

In considering the uses of honey in cookery, it is well to remember that it owes its flavor to bodies which are very volatile and that for this reason it should not be heated unnecessarily hot or unnecessarily long.

In order to learn how honey is used in cookery, standard cookbooks from many countries were examined and many persons familiar with honey cookery were consulted. Innumerable as the recipes were, it was soon found that they belonged mainly to only a few different types, such as breads made with honey, honey cakes made with or without butter, fruits preserved in honey, and sauces and candies made with honey. Many recipes were tested in this laboratory, and some of the more desirable ones were adapted for use in the United States and are published here.

BREAD AND MUFFINS.

Honey is not often used in bread making but there is no reason why it may not be used in yeast bread as food for the yeast plant or be substituted for molasses or sugar in varieties of bread which call for such sweetening. A few recipes are here given.

Bran Brown Bread.

1 cup white or whole wheat flour.
1 teaspoon soda.
½ teaspoon salt.
1 cup bran.
½ cup honey.
1 cup sour milk.
½ cup raisins floured.

[1] The Twentieth Century Book for the Progressive Baker. By F. L. Glenandt. Boston, 1913, p. 129.

Sift together the flour, soda, and salt, and add the other ingredients. Steam three hours or bake 40 minutes in a slow oven. If the amount of milk is increased by half, the bread is more delicate and has a somewhat higher food value.

Steamed Brown Bread.

1 cup yellow corn meal.
2 cups graham flour.
¾ cup honey.
2 cups sour milk.
1 teaspoon salt.
1½ teaspoons soda.
1 tablespoon boiling water.
1 cup seeded raisins.

Mix together the meal, flour, and salt; add the sour milk and the honey and then the soda dissolved in the boiling water; and the raisins. Steam three hours in covered receptacles, which should be not more than two-thirds full at the beginning of the cooking.

Honey Bread.

2 cups honey.
4 cups rye flour.
1 teaspoon soda.
4 teaspoons aniseed.
2 teaspoons ginger.
4 teaspoons powered cardamom seed.
2 egg yolks.
½ cup brown sugar.

Sift the flour with the spices and soda and add the other ingredients. Put the dough into shallow buttered pans to the depth of about an inch and bake in a hot oven.

Honey and Nut Bran Muffins.

½ cup honey.
1 cup flour.
½ to ¾ teaspoon soda.
½ teaspoon salt.
2 cups bran.
1 tablespoon melted butter.
1½ cups milk.
¾ cup finely chopped English walnuts.

Sift together the flour, soda, and salt, and mix them with the bran. Add the other ingredients and bake for 25 or 30 minutes in a hot oven in gem tins. This will make about 16 large muffins, each of which may be considered roughly to be a 100-calorie portion and to contain 2 grams of protein.

Honey and Nut Sandwiches.

Mix the honey with pecan meats or almonds minced, and make into sandwiches with small baking-powder biscuits.

Honey and Cream Cheese Sandwiches.

Mix honey with cream cheese and use as filling for bread or baking-powder biscuit sandwiches. Chopped nut may be added to the honey and cheese if desired.

CAKES, COOKIES, ETC.

By far the most general use of honey in cookery is for cakes. Of these there is an almost endless variety, from rich fruit cake in loaves or elaborate pastries with honey filling to simple cookies. As has been pointed out, the honey flavor combines especially well with spices. The presence of honey also makes the cakes keep fresh longer. These two facts probably explain why the honey cakes, which belong mainly to the general order of gingerbreads or spice

cakes, are so largely produced by commercial bakers. Many of these are rather elaborate to make, and for that reason some of the simpler kinds of honey cakes may be preferred by the busy housekeeper.

Hard Honey Cake.

¾ cup honey.
½ cup sugar.
2½ cups flour.
1 egg.
½ teaspoon ginger.
1 teaspoon cinnamon.
½ teaspoon ground cardamom seed.
½ teaspoon cloves.
Speck white pepper.
Speck salt.
½ teaspoon soda.
1 tablespoon water.
2 ounces blanched almonds cut into small pieces or chopped.

Sift together the flour and spices, dissolve the soda in the water, beat the egg and combine all the ingredients. Beat or knead the mixture thoroughly. Cook a small sample. If it does not rise sufficiently, add a little more soda and honey; if it falls, add a little more flour. Roll out the dough to the thickness of about three-fourths of an inch and bake in a hot oven. When the cake is done glaze it with a thick sirup of sugar and water and allow it to dry in a slow oven or in some other warm place. While it is still warm, cut it into long strips. Or it may be left in one large cake, to be cut into very thin slices when served. This cake will become very hard on cooling and will not be soft enough to eat for several weeks, but will keep in good condition for an indefinite length of time.

Butter Honey Cake.

1½ cups honey.
½ cup butter.
3 egg yolks.
5 cups flour.
2 teaspoons ground cinnamon.
½ teaspoon salt.
1½ teaspoons soda.
2 tablespoons orange-flower water (water may be substituted).
Whites 3 eggs.

Rub together the honey and butter; add the unbeaten yolks and beat thoroughly. Add the flour sifted with the cinnamon and the salt; and the soda dissolved in the orange-flower water. Beat the mixture thoroughly and add the well-beaten whites of the eggs. Bake in shallow tins and cover with frosting made as follows:

Orange frosting for butter honey cake.

Grated rind 1 orange.
1 teaspoon lemon juice.
1 tablespoon orange juice.
1 egg yolk.
Confectioners' sugar.

Mix all ingredients but the sugar and allow the mixture to stand for an hour. Strain and add confectioners' sugar until the frosting is sufficiently thick to be spread on the cake.

For the cinnamon in the Butter Honey Cake the following mixture of spices may be substituted:

½ teaspoon ginger.
2 teaspoons cinnamon.
1 teaspoon ground cardamom seed.
1 teaspoon cloves.
¼ teaspoon nutmeg.
¼ teaspoon white pepper.
Chopped citron or nuts may also be added.

This mixture may also be flavored with ginger, aniseed, or cardamom seed.

Butter Honey Cake No. 2.

1 cup honey.
½ cup butter.
½ teaspoon ginger.
½ teaspoon cinnamon.
1 teaspoon ground cardamom seed.
3 eggs.
3 cups flour.
½ to 1 teaspoon soda.
1 ounce candied orange peel.
1 ounce candied lemon peel, or
1 cup seeded raisins.

Mix the honey and butter by warming slightly and stirring; add the spices and the yolks of the eggs unbeaten and beat the mixture thoroughly. Add the flour and the soda dissolved in a little water, then the whites of the eggs beaten stiff, and finally the fruit. Bake in a moderate oven.

Nut Honey Cake.

2 cups brown sugar.
2 cups honey.
6 egg yolks.
3 cups flour.
Speck of salt.
1½ teaspoons soda.
3 teaspoons ground cinnamon.
½ teaspoon ground cloves.
½ teaspoon ground nutmeg.
½ teaspoon allspice.
1 cup chopped raisins.
½ ounce citron cut in small pieces.
½ ounce candied orange peel cut in small pieces.
½ pound almonds coarsely chopped.
Whites of 3 eggs.

Mix the sugar, honey, and the yolks of the eggs, and beat thoroughly. Sift together the flour, salt, spices, and soda. Combine all ingredients but the whites of the eggs. Beat the whites of the eggs till they are stiff and add them last. Pour the dough to the depth of about half an inch into well-buttered tins, and bake in a slow oven for one-half hour.

Frosting for Nut Honey Cake.

1½ cups sugar.
3 egg whites.
½ cup water.

Boil the sugar and water until the sirup forms a thread when dropped from the spoon. While still hot, pour the sirup over the well-beaten whites of the eggs, beating the mixture until it is of the right consistency to spread.

Chocolate Nut Honey Cake.

To the above cake add 3 ounces of chocolate grated.

Soft Honey Cake.

½ cup butter.
1 cup honey.
1 egg.
½ cup sour milk.
1 teaspoon soda.
½ teaspoon cinnamon.
½ teaspoon ginger.
4 cups flour.

Rub the butter and honey together; add the egg well beaten, then the sour milk and the flour sifted with the soda and spices. Bake in a shallow pan.

Honey Sponge Cake.

½ cup sugar.
½ cup honey.
4 eggs.
1 cup sifted flour.

Mix the sugar and honey and boil until the sirup will spin a thread when dropped from the spoon. Pour the sirup over the yokes of the eggs which have been beaten

until light. Beat this mixture until cold; then add the flour, and cut and fold the beaten whites of the eggs into the mixture. Bake for 40 or 50 minutes in a pan lined with buttered paper, in a slow oven.

This cake can be made with a cupful of unheated honey in place of the honey and sugar sirup, but the quality is not quite so good.

Honey Pound Cake.

A good pound cake can be made by using equal weights of honey, sugar, eggs, flour, and butter. A little soda should be added because of the acidity of the honey, and a good flavoring is cardamom seed and orange-flower water. Or a cake similar to pound cake may be made as follows:

1 cup sugar.
½ cup honey.
1 cup butter.
4 eggs.
2 cups pastry flour.
½ teaspoon powdered cardamom seed.
½ teaspoon soda.
½ teaspoon orange-flower water.

Rub together the butter and sugar, and add the honey. Add the yolks of the eggs well beaten. Finally, add the whites of the eggs, beaten to a stiff froth, and the orange-flower water. Add gradually the flour sifted with the soda and cardamom seed. Beat the mixture for 10 minutes. Put the dough into a warm tin with high sides, and bake in a slow oven one hour.

Ribbon Cake.

UTILIZING CANDIED HONEY AS FILLING.

½ cup butter.
2 cups sugar.
4 eggs.
1 cup milk.
3½ cups flour.
5 teaspoons baking powder.
1½ teaspoons ground cardamom seed.
1½ teaspoons ginger.
¾ teaspoon cinnamon.
¼ teaspoon cloves.
½ cup raisins, seeded and cut in pieces.
½ cup figs, finely chopped.
1 tablespoon honey.

Rub the butter and sugar together and add the yolks of the eggs. Sift together the flour and baking powder and add them to the mixture, alternating them with the milk. Finally, add the whites of the eggs well beaten. Bake two-thirds of the mixture in two layer-cake pans. To the remainder add spices, fruit, and honey, and bake in a layer-cake pan. Put layers together with crystallized honey.

Honey Fruit Cake.

3 cups flour.
2 teaspoons soda.
3½ cups honey.
1 cup butter.
6 eggs.
2 teaspoons cinnamon.
2 teaspoons ginger.
3 teaspoons ground cardamom seed.
½ teaspoon cloves.
3 pounds raisins (seeded).
1½ pounds currants.
1 pound citron.
1 pound candied cherries.
1 pound candied apricots.
1 pound candied pineapple.
½ cup sour jelly, or
½ cup white grape juice.
2 teaspoons vanilla.
2 ounces candied orange peel.
2 ounces candied lemon peel.

Cut the candied fruit into small pieces, with the exception of the cherries, which should be left whole. Place the fruit in a large dish and sift over it one-half of the flour, mixing thoroughly. Sift the soda with the remainder of the flour. Bring the honey and the butter to boiling point and while still hot add the spices. When the mixture is cool, add the well-beaten yolks of the eggs, then the flour and grape juice or jelly and the well-beaten whites. Finally, add the fruit. The cake should be divided into three or four parts and put into buttered dishes covered with buttered paper tied closely over the tops. Steam for five hours, remove the paper, and bake in a very slow oven for an hour. This makes a very rich cake consisting chiefly of fruit. For the sake of economy, the flour can be increased to even twice the quantity without affecting the quality very much.

Honey Fruit Cake No. 2.

4 cups flour.
3 teaspoons soda.
2 cups honey.
1 cup butter.
6 eggs.
2 teaspoons cinnamon.
2 teaspoons ginger.
3 teaspoons ground cardamom seed.
½ teaspoon cloves.
3 pound raisins (seeded).
4 ounces citron.
1 pound cranberries.
1 pound canned pineapple.
1 pound dried apricots.
1 pound dried apples.

To prepare the cranberries, pineapples, apricots, and apples, cook each in honey till it is soft; remove from the honey and dry in a very slow oven. A little water should be added to the honey in which the cranberries are cooked, a good proportion of ingredients being equal weights of cranberries, water, and honey. To any honey left over from cooking the fruits add enough honey to make up the total amount called for by the recipe. Mix and cook the cake in the same manner as honey fruit cake No. 1.

Honey Drop Cakes.

½ cup honey.
¼ cup butter.
½ teaspoon cinnamon.
⅛ teaspoon cloves.
1 egg.
1½ to 2 cups flour.
½ teaspoon soda.
2 tablespoons water.
1 cup raisins, cut into small pieces.

Heat the honey and butter until the butter melts. While the mixture is warm add the spices. When it is cold add part of the flour, the egg well beaten, the soda dissolved in the water, and the raisins. Add enough more flour to make a dough that will hold its shape. Drop by spoonfuls on a buttered tin and bake in a moderate oven.

Yellow Honey Cake.

½ cup sugar.
2 egg yolks.
⅔ cup honey.
¼ teaspoon cinnamon.
⅛ teaspoon cloves.
1½ cups flour.

Sift together the flour and the spices. Mix the sugar and egg yolks, add the honey, and then the flour gradually. Roll out thin, moisten the surface with egg white, and mark into small squares. Bake in a moderate oven.

Honey Cookies No. 1.

- ⅔ cup honey.
- ⅔ cup sugar.
- 2½ cups flour.
- ½ teaspoon soda.
- 1½ teaspoons cinnamon.
- 1 teaspoon cloves.
- 1 teaspoon allspice.
- 2 ounces finely chopped candied orange peel.
- ¼ pound walnut meats finely chopped.

Sift together the flour, spices, and soda, and add the other ingredients. Knead thoroughly, roll out thin, and cut with a biscuit cutter. These cookies are very hard.

Honey Cookies No. 2.

- ¼ cup honey.
- ⅔ cup sugar.
- ½ cup milk.
- 3 tablespoons lard.
- 2 egg yolks.
- 4 cups flour.
- ½ teaspoon salt.
- 1 teaspoon ground cinnamon.
- ½ cup finely chopped almonds.
- ½ teaspoon soda or 2 teaspoons baking powder.

Bring the first four ingredients to the boiling point and allow the mixture to cool. Sift together the flour, cinnamon, and soda or baking powder. Combine all the ingredients. Roll the mixture out thin on a floured board. Cut out and bake in a moderate oven on tins which have been greased and floured. To prepare the tins properly, brush them over with melted butter and sifted flour, turn them over, and shake off as much as possible of the flour.

Honey Cookies No. 3.

- ¼ cup water.
- 1 pound brown sugar or 2 cups packed solidly.
- ½ cup lard.
- 1 cup honey.
- ⅓ cup egg yolks.
- 1 teaspoon soda.
- 6 cups flour.
- 1 teaspoon powdered cardamom seed.
- 1 teaspoon cinnamon.

Heat the water, sugar, lard, and honey until the lard is melted. When cool, add the yolks of the eggs and the flour, sifted with the soda, and spices. Roll out on a floured board and cut into any desired shape. Place a small piece of citron in the middle of each cooky.

Honey Bran Cookies No. 1.

- 2 tablespoons butter.
- ½ cup honey.
- 2 eggs.
- ¼ to ½ teaspoon soda.
- ½ cup flour.
- 1 cup bran.
- ⅛ teaspoon powdered aniseed.

Rub together the butter and honey; add the eggs unbeaten and beat the mixture thoroughly. Sift together the flour, soda, and aniseed. Combine all the ingredients; drop from a teaspoon on to a buttered tin and bake in a moderate oven.

Honey Bran Cookies No. 2.

- 3 cups bran.
- ½ cup sugar.
- ¼ to ½ teaspoon soda.
- ¼ teaspoon cinnamon.
- ¼ teaspoon ginger.
- ½ cup honey.
- ½ cup milk.
- ½ cup melted butter.

Mix the sugar, cinnamon, ginger, and soda with the bran and add the other ingredients. Drop from a spoon upon a buttered pan and bake about 15 minutes.

Rolled Honey Wafers No. 1.

½ cup butter.
¾ cup honey.
⅞ cup flour.
¼ teaspoon powdered cardamom or aniseed.

Mix together the butter and honey and add the flour, sifted with the spice. Spread out very thin with a broad long-bladed knife or spatula on a buttered, inverted dripping pan, or on flat tins made for the purpose. Mark off in 3-inch squares and bake in a slow oven until delicately browned. While warm, roll into tubular shape and hold until they cool and, if necessary, until they harden into shape. Honey wafers are not quite so tender as those made with sugar.

Rolled Honey Wafers No. 2.

½ cup honey.
½ cup sugar.
½ cup butter.
⅞ cup flour.
½ cup milk.
½ teaspoon cardamom or aniseed.

Cream the butter; add the sugar, honey, and flour in the order named, and the milk very gradually. Cook as rolled honey wafers No. 1.

Nougat Wafers.

½ cup butter.
1 cup brown sugar.
½ cup milk.
⅞ cup bread flour.
4 teaspoons ginger, or
2 teaspoons powdered cardamom or aniseed.

Rub together the butter and the sugar and add alternately the milk and the flour sifted with the spices. Spread in a very thin layer on the bottom of an inverted dripping pan or on flat tins made for the purpose. Mark off into pieces about an inch wide and 4 inches long and put together in pairs with honey nougat filling made as follows:

Honey filling for nougat wafers.

1 cup sugar.
½ cup honey.
½ cup water.
2 egg whites.

Boil the sugar, water, and honey together until the sirup makes a thread when dropped from a spoon, or until drops of it hold their shape when poured into cold water. Beat the eggs to a stiff froth, pour the sirup over them, put the dish holding the mixture in a place where it will keep warm but not cook rapidly, beat until it will hold its shape.

Honey Rissoles.

Pastry covering for rissoles.

½ cup lard.
2 egg yolks.
1 egg white.
⅔ cup water.
¼ cup brown sugar.
Flour.

Mix together all the ingredients but the flour and add enough of that to make a stiff dough. Roll out as thin as a knife blade, cut into round or square pieces, taking care to avoid the necessity of rolling out the second time, as this is likely to make the dough very tough. A honey filling is used with this dough and is made as follows:

HONEY FILLING FOR RISSOLES.

1 cup honey.
2 ounces candied orange peel.
Rye bread crumbs.
Aniseed.

Bring the honey to the boiling point, remove from the stove, and add as much bread crumb as it will moisten while it is hot. Add the orange peel and enough powdered aniseed to give a decided flavor. Roll this filling into small balls and lay one in the center of each piece of pastry; fold the pastry over and press the edges together. Bake in a hot oven.

DESSERTS.

The following recipes suggest ways in which honey can be substituted for sugar or molasses in many common desserts. The ingenious cook with honey to spare can easily work out others if she remembers what was said on pages 11 and 12 about the sweetening power and water and acid content of honey:

BAKED HONEY CUSTARD.

5 eggs.
½ cup honey.
4 cups scalded milk.
⅛ teaspoon powdered cinnamon.
¼ teaspoon salt.

Beat the eggs sufficiently to unite the yolks and whites, but not enough to make them foamy. Add the other ingredients and bake in cups or in a large pan in a moderate oven. The baking dishes should be set in water.

BOILED HONEY CUSTARD.

2 cups milk.
3 egg yolks.
½ cup honey.
⅛ teaspoon salt.

Mix the honey, eggs, and salt. Scald the milk and pour it over the eggs. Cook in a double boiler until the mixture thickens. This custard is suitable for use in place of cream on gelatin desserts, or to be poured over sliced oranges or stewed fruit.

HONEY PUDDING.

½ cup honey.
6 ounces bread crumbs.
½ cup milk.
Rind of half a lemon.
½ teaspoon ginger.
2 egg yolks.
2 tablespoons butter.
2 egg whites.

Mix the honey and the bread crumbs and add the milk, seasonings, and yolks of the eggs. Beat the mixture thoroughly and then add the butter and the whites of the eggs well beaten. Steam for about two hours in a pudding mold which is not more than three-quarters full.

HONEY CHARLOTTE RUSSE.

1 quart cream.
6 lady fingers.
½ cup delicately flavored honey.

Chill the honey by placing the dish containing it in a pan of ice water. Whip the cream and add it to the honey, mixing the two well. Line a dish with lady fingers and fill it with the honey and cream. Serve very cold.

HONEY MOUSSE.

4 eggs.
1 pint cream.
1 cup hot, delicately flavored honey.

Beat the eggs slightly and slowly pour over them the hot honey. Cook until the mixture thickens. When it is cool, add the cream whipped. Put the mixture into a mold, pack in salt and ice, and let it stand three or four hours.

HONEY ICE CREAM No. 1.

1 quart thin cream. ¾ cup delicately flavored honey.

Mix ingredients and freeze.

HONEY ICE CREAM No. 2.

1 pint milk. 1 cup honey.
Yolks 6 eggs. 1 pint cream.

Heat the milk in a double boiler. Beat together the honey and eggs, add the hot milk, return the mixture to the double boiler, and cook it until it thickens. Add the cream and when the mixture is cool, freeze it.

PRESERVED FRUITS.

CURRANTS.

Bar-le-Duc currants, an article of commerce often made with honey, sell for a relatively high price, in part no doubt because of the large amount of labor involved in preparing them. The seeds are removed from the currants by a method which mutilates the fruit very slightly; the fruit is then preserved in honey or sugar sirup. Those who wish to take the time to preserve currants in this way will find that a convenient way to remove the seeds is to cut a small slit in the side of each currant and remove the seeds by means of a needle. After this is done, weigh the currants and take an equal weight of honey. Bring the honey to the boiling point, add the currants, and allow them to cook at the boiling point for two or three minutes, or until the skins are tender, being careful not to let the mixture boil violently because this is likely to destroy the shape of the fruit. If the currants are so juicy as to liquefy the honey too much, they may be removed and the sirup reduced to the desired consistency, after which the currants may be replaced.

It is possible, of course, to preserve currants in honey according to the same recipe without the removal of the seeds, but the preserve thus obtained is not nearly so delicate as when the seeds are removed.

CRANBERRIES.

A very good preserve may be made from cranberries and honey which will remain in good condition for a long time. Take equal weights of cranberries, honey, and water. Cook the berries in the honey and water until the skins are soft. Remove the berries and boil down the sirup until just enough remains to cover the berries. Pour into glasses and cover as you would jelly. The appearance of the cranberries is improved if each one is pricked several times before cooking and if the cooking is slow at first. This gives the sirup an opportunity to penetrate the berries without destroying their form. A satisfactory method is to place all the ingredients in a double boiler and heat them very slowly. If this method is followed, the boiling down of the sirup is even more necessary than when the berries are cooked more rapidly.

STRAWBERRIES.

Take equal weights of strawberries and honey; mix the two and dry in the sun, or preferably in a warm oven; put into carefully sterilized glasses and cover with paraffin.

APPLES.

2 quarts apples cut into small pieces. 1 cup vinegar.
2 cups honey. 1 teaspoon cinnamon.

Heat the honey, vinegar, and cinnamon together and cook the apples, a few at a time, in the sirup until they become transparent. Pour the sirup which remains after all the fruit is cooked over the apples.

Fruit and Honey Jelly

A good jelly may be made from winter apples and honey, using a cupful of honey to each cupful of apple juice and proceeding as in ordinary jelly-making. Honey could probably be used with other fruits suitable for jelly, but no definite directions have been worked out in this laboratory. The more delicately flavored honeys are probably best for this purpose, alfalfa giving an especially spicy taste.

ICING, SAUCES, CANDIES, ETC.

Honey Icing.

1 cup granulated sugar.
½ cup water.
½ cup honey.
1 egg white.

Boil together the sugar and the water for a few moments and then add the honey, taking precautions to prevent the mixture from boiling over, as it is likely to do. Cook until drops of the sirup keep their form when poured into cold water, or to about 250° F. Beat the white of the egg until stiff, and when the sirup has cooled slightly pour over the egg, beating the mixture continuously until it will hold its shape. This frosting is suitable for use between layers of cake, but is rather too soft for the top. It remains in good condition and soft enough to be spread for many weeks and, therefore, can be made in large quantities for use as needed. After eight months, such icing made in this laboratory was found to be in good condition and soft enough to cut.

Sauce for Ice Cream.

2 tablespoons butter.
2 teaspoons cornstarch.
½ cup honey.

Cook together the cornstarch and butter thoroughly, being careful not to brown them. Add the honey and cook the mixture until it becomes hard when dropped into cold water and until all taste of raw cornstarch has been removed.

Pudding Sauce.

If a small quantity of water be added to the above sauce, its consistency is entirely changed; it becomes thinner and can not be made brittle even by dropping it into cold water. It is suitable for serving on various kinds of puddings.

Strawberry Sauce.

Strawberry sauce, for puddings or boiled rice, which is usually made by mixing butter, sugar, and mashed berries, is a good means of securing the strawberry flavor at times when berries are too high-priced to be used in large quantities. The substitution of honey for sugar has proved to be practicable. In fact, it obviates one of the chief difficulties in making this sauce—the tendency to curdle.

2 tablespoons butter.
¾ cup mashed strawberries.
½ cup honey.

Beat together the honey and butter. Add the strawberries slowly, keeping the mixture cool by setting the dish in water. Serve on boiled rice or cottage pudding.

Salad Dressing.

4 egg yolks.
2 tablespoons vinegar or lemon juice.
2 tablespoons butter.
2 tablespoons honey.
1 teaspoon mustard.
1 teaspoon salt.
Paprika to taste.
1 cup cream.

Heat the cream in a double boiler. Beat the eggs, and add to them all the other ingredients but the cream. Pour the cream slowly over the mixture, beating constantly. Pour it into the double boiler and cook until it thickens, or mix all the ingredients but the cream and cook in a double boiler until the mixture thickens. As the dressing is needed combine this mixture with whipped cream. This dressing is particularly suitable for fruit salads.

Nougat.

⅔ cup honey.
½ cup brown sugar.
1 pound almonds.
2 egg whites.

Boil the honey and sugar together until drops of the mixture hold their shape when poured into cold water. Add the whites of the eggs, well beaten, and cook very slowly, stirring constantly, until the mixture becomes brittle when dropped into water. Add the almonds and cool under a weight. The candy can be broken into pieces, or may be cut and wrapped in waxed paper.

Honey Fudge.

2 cups sugar.
½ cup honey.
½ cup water.
2 egg whites.
1 teaspoon of vanilla extract.

Boil together the sugar, honey, and water until the sirup spins a thread when dropped from a spoon (about 250° F.). Pour the sirup over the well-beaten whites of the eggs, beating continuously and until the mixture crystallizes, adding the flavoring after the mixture has cooled a little. Drop in small pieces on buttered or paraffin paper. The vanilla may be omitted.

Honey Caramels.

2 cups granulated sugar.
½ cup cream or milk.
½ cup honey.
¼ cup butter.

Mix the ingredients; heat and stir until the sugar is dissolved; then cook without stirring until a firm ball can be formed from a little of the mixture dropped into cold water. Beat the mixture until it crystallizes, pour into buttered pans, and cut into squares. The addition of pecan nuts improves these caramels.

Honey Popcorn Balls.

Honey can be heated up to about 245° F. without being greatly changed in color or flavor. If it is heated carefully most of the water is expelled. The honey then becomes hard on cooling and can be used for making popcorn balls. To make them, dip the popped corn into the hot honey, shape into balls and cool. Honey popcorn balls absorb moisture on standing in the air. They must therefore be either kept very closely covered or reheated and dried before being used.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 654 APRIL 3, 1915.

Contribution from the Office of Markets and Rural Organization, Charles J. Brand, Chief.

HOW FARMERS MAY IMPROVE THEIR PERSONAL CREDIT.

By C. W. THOMPSON, *Specialist in Rural Organization Work.*

INTRODUCTION.

In this bulletin two general methods whereby farmers may improve their personal credit will be considered: That of temporary agreements with existing loan agencies, agreements terminating with the payment of the loans, and that of permanent articles of agreement among the farmers themselves, or "cooperative credit associations."

TEMPORARY AGREEMENTS WITH EXISTING LOAN AGENCIES.

Three different plans are here presented by which farmers have improved their personal credit with local banks. Each plan has enabled farmers to borrow money at reduced rates of interest and on more favorable terms of repayment than usual. The loans secured under these plans were all used for the purchase of improved dairy stock. However, it is believed that similar arrangements would help farmers to improve their credit in connection with other farm enterprises, such as cattle breeding, and hog raising, or in securing suitable farm equipment.

PLAN I.

Under Plan I, farmers enter into an agreement with local bankers or with other persons who supply the loans to adopt a uniform and approved system of dairy improvement. The security given by the farmers is not different from that ordinarily required. Those furnishing the funds also buy the dairy stock, usually under the advice

NOTE.—This bulletin is intended to give to farmers some practical methods for improving their personal credit through cooperation. It should be of interest to farmers generally, and particularly to those of the South and of the West.

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of dairy specialists connected with the State or Federal Government. The stock is sold to the farmers at actual cost plus a certain percentage (say, 2 per cent) to cover incidental expenses. The lender takes in payment the farmer's personal note with or without indorsement, or with mortgage security on the stock purchased.

Under this plan, as worked out in certain localities in North Dakota, the farmer has borrowed money on his personal note with interest at 8 per cent, whereas the usual local rate is 10 or 12 per cent. The notes were drawn for periods varying from six months to a year, but permitted renewals and partial prepayments on the principal. A modified sample of the memorandum drawn up between the bankers and farmers is given below.

SAMPLE OF MEMORANDUM USED.

THIS MEMORANDUM, made this ..... (Date.) day of ..... (Month.), 19... (Year.)

WITNESSETH that whereas ..... (Name of lender.) proposes to furnish cows and heifers of ..... (Name of breed.) breed and ..... (Name of breed.) bulls, purchasing the same at such points in ..... (Locality.) as may be deemed most advantageous, selling them to the undersigned at the actual cost thereof laid down at the stations of ..... (Names of stations.), plus ..% to be added to such cost to cover incidental expenses incurred in connection with the proposition; and

WHEREAS said ..... (Name of lender.) has agreed to accept in payment for such cattle individual notes from the undersigned purchasers thereof to the amount of such purchase on the basis above named, such notes to be made payable on ..... (Date.) and to bear interest from date of the purchase of such cattle at the rate of ..% per annum and to be made payable to said ....., or such payee as he may name, said ..... (Lender.) agreeing that upon the prompt payment at the maturity of said notes of the interest due and one-half of the principal of such notes, the balance is to be renewed for six months at the said rate of ..% per annum; and, further, that upon the prompt payment of the interest due at the maturity of such renewal the principal of such notes will be renewed for the further term of six months, with interest at the rate of ..% per annum; and

WHEREAS in the shipping of such cattle there may be possible loss on account of injury, or otherwise, it is agreed that any such losses shall be added to the cost of such cattle, the amount thereof being spread over the entire purchase, so that each purchaser shall bear his proportionate share thereof, and

WHEREAS it is proposed that in the distribution of such cattle the respective purchasers shall pay for each individual animal the price for which such individual was purchased plus the pro rata expense of purchasing and delivering the same, together with the said amount of .. per cent added thereto, and

WHEREAS it is proposed that in the distribution of such cattle to the respective purchasers thereof, the four, five, or six, or more persons to whom shall be allotted any particular car of such cattle shall draw numbers from one to four, five, or six, or more, as the case may be, the one drawing number one having first selection of one from the cattle contained in such car, the one drawing number two having second selection of

one, and so on, until each of such persons shall have selected one animal from the cattle contained in such car. This procedure shall be repeated until all the cattle in such car shall have been selected, each individual dropping out after having selected the number which he agreed to purchase.

NOW, THEREFORE, we, the undersigned, hereby agree upon the conditions hereinbefore set forth to purchase the number of cows or heifers set opposite our respective names, agreeing to take one, more or less, than such number if in the adjustment of the distribution it is necessary so to do, and further agreeing to take such cattle at either one or the other of the two places named opposite our respective names, further agreeing that upon being notified of the day on which such cattle are expected to arrive at the respective points to be on hand promptly to receive same and to make settlement therefor.

Name.	Number of cows or heifers.	To be delivered at—
.....	.....	.....
.....	.....	.....

The same general plan was carried out during the fall of 1912 with a group of farmers in southern Idaho. In that instance, three or four banks took up the work together, each agreeing to finance a carload of dairy stock.[1]

As a third example may be cited the work undertaken in a western Nevada community in the summer of 1913. Here the financial backers of a local creamery supplied the loans. The farmers gave indorsed paper together with mortgages on the stock purchased. The creamery withheld a part of the returns from milk and cream delivered, as shown in the following modified section of their agreement:

MODIFIED SECTION OF AGREEMENT.

THE UNDERSIGNED, jointly and individually, promise to pay to the ..... (Name.) Creamery the sum of ..... (Amount.) dollars, to be paid as follows:

All butter fat produced by cows sold under this agreement to the undersigned shall be delivered to the ..... (Name.) Creamery at its plant at such times as said ..... (Name.) Creamery shall request, and that said ..... (Name.) Creamery may withhold one-half (½) the amount to be paid to us for cream and milk delivered; said amount to be applied upon the payment of the principal sum herein mentioned. Provided that said payment so made shall not be less than two and 50–100 ($2.50) dollars per month per cow, and if said amount is less than said amount per month per cow, the undersigned, jointly and individually, promise to pay said ..... (Name.)

[1] The Reclamation Service, Department of the Interior, the Office of Western Irrigation Agriculture, of the Bureau of Plant Industry of this Department, and private interests, have been fostering community organization for better credit facilities on certain reclamation projects, particularly in connection with the purchase of dairy stock on some of the northern projects, and for the commercial handling of cotton on some of the southwestern projects.

Creamery any deficiency so arising in cash to make up the sum of two and 50–100 ($2.50) dollars per cow per month on account of the principal sum herein mentioned. The undersigned, jointly and individually, further agree to pay to said ..... (Name.)

Creamery interest at the rate of ..... (Rate.) per cent per annum, payable monthly, on all deferred payments.

Under this agreement, 491 cows and heifers were shipped in and distributed among 64 farmers. The loans made through the creamery amounted to $39,483.

These examples illustrate the way in which farmers in some sections have agreed upon a uniform and approved system of dairy improvement and how this has enabled them individually to secure the necessary credit from local banks on more favorable terms than usually prevail in this community. There are regions, however, where such arrangements are not sufficient to enable farmers as individuals to attract the necessary capital. Some additional security is necessary in addition to what each farmer is able to furnish.

PLAN II.

In the plan here described this additional security is supplied by having the farmers collectively assume a certain guarantee for the notes given by the members under the agreement. An illustration of how this has worked out is afforded on an irrigation project in southern Montana. Nineteen farmers organized an association and appointed trustees to represent the association in dealing with a local bank. The trustees were authorized to guarantee a limited amount to the bank on the joint and several liability of the association members. By adding this guarantee to the security offered by the individual farmers, the latter were able to secure the necessary capital for the purchase of two carloads of heifers which were shipped in from another State in August, 1913. The local bank placed $5,000 to the credit of the association at 8 per cent, whereas the general bank rate is 10 per cent or, more frequently, 12 per cent. In this instance, two men from the association were sent to make the purchase. After the stock had been secured, a proportionate share of all outlay, such as freight, travel and incidentals, was added to the purchase price of each animal, and charges were made accordingly. As in the illustration given from western Nevada, provision was made for the periodic payment of the loans out of the dairy products. The articles of agreement also provided that the purchaser should give the animals proper care and breed them only in such a manner as the trustees might approve. Such safeguards are a desirable feature of any contract of this kind. A portion of the articles of agreement, slightly modified, follows:

ARTICLES OF AGREEMENT.

WE, the undersigned, for the purpose of promoting the dairy industry on the ....., do hereby associate ourselves
(Name of project or locality.)
together under the name of ....., and do
(Name of association.)
hereby, each with the other, in consideration of the mutual benefits to be derived from such an association, and of the mutual covenants and agreements herein contained, agree as follows:

First. The business of this association shall be to buy and sell dairy stock and the products thereof and to assist the members hereof in getting a start in the dairy business.

Second. The management of the business shall be vested in a board of three (3) members who shall be known as trustees, and shall be elected by the majority vote of all members at the annual meeting as hereinafter provided.

Third. The trustees shall have the power for and in the name of the association to purchase not to exceed ..... milk cows or heifers at any one time and
(Number.)
not to exceed ..... bulls at any one time, said stock to be sold only to the
(Number.)
members, provided that any surplus stock may be sold to outside parties.

Fourth. For the purpose of obtaining funds necessary to purchase, care for, and deliver such cattle, including the expenses incident thereto, the trustees are hereby authorized to borrow funds upon such terms and conditions as they may deem best; and to this end such trustees are hereby made the agents of each person whose name is hereunto affixed, with full power to incur such obligations, the same to be the valid, joint, and several legal obligation upon each member of the association in the same manner as if each one personally signed and executed the same. Provided that in no event shall the total amount of the indebtedness thus created against the members of this association exceed the sum of ..... dollars
(Amount.)
at any one time. Such obligations shall be made in the name of the association and shall be signed by each of the trustees.

Fifth. Such cattle may be sold to the members on time and on such terms as the trustees may fix, in which event the purchasing member shall give a chattel mortgage on the cattle so purchased, together with their increase, to secure the unpaid purchase price, along with such other security as the trustees may agree upon; all such papers shall be transferred as security for any money borrowed by the trustees as herein provided. No sales shall be made to any person not a member of the association except for cash.

Sixth. Each person whose name is affixed hereto who may become indebted to the association on account of any such purchase hereby expressly agrees that he will take proper care of the cows obtained as herein described; that he will breed them only to such bulls as the trustees may approve; that the trustees shall have the option to purchase said cattle and their increase, in the event any member desires to sell, at the market price. It is further expressly agreed that if, in the judgment of the trustees, any member indebted to the association is not taking proper care of the cattle on which the association holds a lien or if such member shall violate any of the provisions of this agreement, then and in that event the trustees may take possession of said cattle and resell them, and out of the proceeds of such sale may first deduct the cost and expense incident thereto; second, the indebtedness due thereon to the association, and any sum remaining shall be paid over to such member.

Seventh. The annual meeting of the members shall be held on the ...., at which time the trustees shall be elected, who (Date.) shall hold office for one year or until their successors are elected. Each member shall be entitled to one vote at such meeting. The trustees shall make a full report at the annual meeting of all business done by them. Special meetings may be called by the trustees by giving three (3) days' notice to the members of the time and place of holding the meeting. Also special meetings of the members may be called by any five (5) members by giving the same notice. The trustees, or any one of them, may be removed from office at any special meeting by two-thirds (⅔) vote of all the members, at which time a successor or successors shall be elected to fill out the unexpired term of such trustee or trustees.

Eighth. The trustees shall be compensated for their services as agreed by the members in their annual meeting, funds for this purpose being raised by levying against each member in proportion to the number of cows owned.

Ninth. The trustees shall not have the power to incur any indebtedness other than as herein authorized or as may be authorized by a two-thirds (⅔) vote of all the members.

Tenth. The trustees shall elect one of their number as the chairman, one as treasurer, and one as secretary, who shall perform the duties incident to such offices.

Eleventh. This agreement shall continue in force for the period of three (3) years from and after the date hereof, provided it may be sooner dissolved by a two-thirds (⅔) vote of all the members if at the time the association is out of debt.

Twelfth. This agreement may be altered or amended at any regular or special meeting of the members by a two-thirds (⅔) vote of all the members.

Dated this ..... day of ....., 191..... (Date.) (Month.) (Year.)

Signed:[1] .....

.....

.....

PLAN III.

If, in place of the limited guarantee supplied by farmers themselves jointly, as described under Plan II, a similar guarantee from a third party be substituted, the essential features of Plan III will be the result. Such a plan was carried out in northwestern Wisconsin in the spring of 1913 and in northeastern Minnesota in the winter of 1914. The third party consisted of local business men who realized their common interest with the farmers in the general improvement of agricultural conditions in their territory. One agreement was made between the farmers and trustees appointed by bankers, and another agreement between the trustees and business men. The latter subscribed a certain percentage of the funds loaned, with the understanding that the money was to be a guarantee fund to protect the bankers. The first purchase made under this plan in northwestern Wisconsin included several carloads of dairy stock,

[1] The foregoing agreements make of the members either a partnership or a voluntary association, according to the statutes and court decisions of the State in which signed. It is suggested, therefore, that farmers desiring to enter into such agreements should secure the necessary legal advice.

the advances from the banks amounting to $9,475. One form of application and agreement made between the farmers and trustees under Plan III is given below:

APPLICATION AND AGREEMENT.

The undersigned hereby applies to..... (Names of trustees.) trustees appointed by the banks of....., (Locality.) for the loan of ..... (Amount.) dollars, or a sufficient sum to purchase.....cows. (Number.)

The cows are to be of.....and..... (Name of breed.) (Name of grade.)

The following is a true statement of the undersigned's resources and liabilities:

RESOURCES.	LIABILITIES.
Description.....	Amount of indebtedness.....$.....
Acres land cleared.....	To whom.....
Value.....$.....	.....
Acres partly cleared.....	Nature of security.....
Value.....$.....	.....
Acres wild.....	
Value.....$.....	
Horses and cattle—Value.....$.....	
Machinery.....$.....	
Other resources.....$.....	

THE UNDERSIGNED, FOR VALUE RECEIVED, hereby agrees to pay to said ....., (Names of trustees.) trustees, or their order, on or before three years from this date, the sum required to pay the entire cost of the cows purchased by him, with interest at 7 per cent per annum, on the unpaid principal, interest payable quarterly.

THE UNDERSIGNED FURTHER AGREES to sell all milk, cream, or butter produced, except the amount consumed by his own family, and cause to be paid to said trustees at stated intervals, each month, from the proceeds of said milk, cream, or butter, not less than three dollars ($3) per month for each cow purchased by him, until the aforesaid sum and interest is fully paid.

THE UNDERSIGNED FURTHER AGREES to breed the cows so purchased to a registered, pure-bred sire of the same breed as the cows so purchased, and to raise all the heifer calves.

THE UNDERSIGNED FURTHER AGREES to secure the payment of said sum and interest and the performance of this agreement, by a chattel mortgage to said trustees, upon the cows so purchased, and the following additional security:

.....

.....

THE UNDERSIGNED FURTHER AGREES to accept the cows that are purchased, and select the same in the following manner:

The cows shall be purchased by some person or persons to be designated by the above trustees or a committee appointed by the guarantors, and they shall buy grade Holsteins for those wanting such, and grade Guernseys for those wanting such, and heifers, either grade Holsteins or grade Guernseys, for those wanting heifers, and shall ship such cows and heifers to..... (Name of locality.) The Holstein cows shall each have a number on a card which shall be attached to the cows at....., (Name of locality).

showing the amount paid for each cow, together with her share of the freight and expense of purchasing all cows and heifers. Then numbers corresponding to the numbers on the cows shall be placed in a box and each farmer desiring to purchase a Holstein cow shall draw as many numbers from such box as the number of cows he desires to purchase, and take the cows which have a corresponding number on the cards attached to them and pay therefor the amount so fixed on the card.

The Guernsey grade cows shall be assigned in the same manner, also the Holstein grade heifers shall be assigned in the same manner, and also the Guernsey grade heifers shall be assigned in the same manner.

In case any cows or heifers are purchased in carload lots or less quantity for a lump um, then the person or persons so purchasing shall apportion the amount, so paid in lump, fixing a price to each cow.

Dated....., 191...

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In presence of:

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PERMANENT ARTICLES OF AGREEMENT AMONG FARMERS: "THE COOPERATIVE CREDIT ASSOCIATION."

The cooperative credit association is not a new experiment. It has been tried out under varying conditions in different countries. A number of active associations in Canada and the United States attest its adaptability to American conditions. It is not essentially or even mainly an urban institution. Farmers have used it successfully and have reaped its benefits.

It is not the purpose of this paper to relate the history of cooperative credit associations. A great deal of published material is available bearing on the work of this type of organization. It is discussed under various names, including the Raiffeisen and Schulze-Delitzsch societies in Germany, the Luzzatti and Wollemborg types in Italy, the cooperative banks of Ireland, Austria, France, and Canada, and the credit unions of the United States. The aim of this bulletin is rather to point out where the need for such an association may be said to exist, what the essential features of the organization are, and what advantages to the farmer may be gained from it.

NEED FOR A COOPERATIVE CREDIT ASSOCIATION.

There are many farmers who realize the importance of improving their equipment and farming methods, but who lack the capital required to make the desired change. At the same time, the terms on which they may be able to borrow the necessary funds are not such as to encourage the use of a loan. Their honesty and industry may be unquestioned, nevertheless their individual security does not command the desired confidence. Where a group of neighboring farmers are thus similarly situated, a cooperative credit association may supply the needed additional security by placing the collective good will of the group behind each of the members. The use of a collective guarantee as applied to a particular undertaking has already been described under Plan II, earlier in this bulletin. In a cooperative credit association, however, collective security is available continuously for such purposes as may be approved by the association. The association also provides for the accumulation and use of local savings, affords training in business habits and procedure, supplies a collective fund for common agricultural purposes, and renders service to its members in other ways, which are not contemplated in the plans previously described.

It is very unfortunate that farmers who suffer from the limitations of their individual personal credit should not take advantage of the benefit of such collective good will. One of the most widespread forms of economic waste among farmers arises from failure to utilize the power of confidence and good will among neighbors. Of course, where conditions are such that neighbors do not trust each other and refuse to cooperate, it is futile to speak of collective power. On the other hand, where farmers are willing to take advantage of the added good will which a neighborly attitude affords, a cooperative credit association proves a helpful agency in promoting the increase of available capital and in strengthening the borrowing capacity of individuals.

The reader may ask why the farmer as a member of a credit association can command confidence and resources which are denied him as an individual. To answer this, it is necessary to show what services a credit association may render each member. Perhaps this can be done best by first explaining how credit associations are organized.

HOW TO ORGANIZE AN ASSOCIATION.

In organizing a cooperative credit association careful study should be given the various features to be embodied in its articles of agreement and by-laws. Proper provision should be made in regard to membership, voting power, the securing of funds, the making of loans, and the necessary officers and committees. In States where cooperative laws are not complete, the association may be organized only as a partnership or voluntary association.

MEMBERSHIP.

The membership of the association should be limited to individuals who live so near together that all are personally acquainted with one another and can keep in touch with one another's work. This makes it necessary to limit the territory to a relatively small area, such as a township or a district. The membership should be restricted also to individuals with industrious habits and of good moral character.

VOTING POWER.

Where such associations are organized without capital stock each member has usually one vote. If ownership of share capital is required for membership and State laws require that voting power be determined according to shares owned, the danger of allowing a few individuals to gain control may be lessened by limiting the number of shares to be held by each individual or by limiting the voting power of any member to a certain percentage (say 10 per cent) of the total vote.

HOW TO SECURE FUNDS.

The funds of the association may be secured through share capital, through deposits, and by borrowing. If share capital is provided, the shares usually are issued in small denominations ($5 is a customary amount) and should be withdrawable at any time. Each member is then required to purchase at least one share. Wherever share ownership is required, payment should be permitted in small installments in order not to deprive anyone of membership. The installment plan of payment also has the advantage that it stimulates the habit of saving among members and encourages the establishment of a reserve fund to protect the financial position of the association. Under proper legal authority a credit association may accumulate funds in the form of deposits. Such deposits should be received at any time, and their accumulation should be encouraged by the payment of a suitable rate of interest and with the option of withdrawal whenever desired, or on thirty days' notice. If the plan is to organize a voluntary association or partnership, care should be taken to note limitations imposed by law bearing on deposit business. Within limits to be determined by the members of the association, if not already fixed by statute, provision also should be made so that the association may borrow money.

HOW TO MAKE LOANS.

As already stated, the main functions of a credit association are to encourage habits of saving, to afford training in business methods, to establish a collective fund for common agricultural purposes, and to provide loans to the members on reasonable terms. The usefulness of the latter function, however, depends upon how it is conducted. In no instance should a loan be granted unless the committee deems it to be productive or for a provident purpose, and believes that the member and the association will be benefited by the loan. Loans should be restricted to members and made only in limited amounts. Generally it has been found unwise to make any loan to officers or members of the standing committees, except by majority vote at members' meetings. A maximum interest rate, as well as a maximum term, should be fixed for all loans, depending upon the economic condition of the locality. Members should be taught to pay all their obligations promptly. Careful attention should be given both to the methods and personnel of the management, in order to insure businesslike procedure in the affairs of the association.

HOW THE ASSOCIATION IS MANAGED.

Authority with reference to the affairs of the association is generally distributed between member meetings, properly convened, and certain committees or boards. The latter usually consists of a

board of directors or managers and a supervisory committee and may include an outside auditor.[1] A separate credit committee may be appointed to perform certain functions otherwise delegated to the board of directors.

The general management of the affairs of the association is usually vested in the board of managers, which controls the admission and expulsion of members. The board passes on requests for loans unless such work is assigned to a special committee. In some countries the board serves as an arbitration tribunal for members who are dissatisfied with the action of other officials. Other officers, such as president, vice president, secretary, and treasurer or manager, are selected from the members of the board and discharge the duties ordinarily associated with their positions.

COMMITTEES ON LOANS AND AUDITING.

When a separate credit committee is provided to pass on all requests for loans, that committee is vested with responsibility for the solvency of the association. To safeguard its work, it is often customary to require that all its actions be taken by unanimous consent. In some cases it is the practice not to allow any of the members to be chosen from the general board. This is done in order that the committee may examine with an open mind and with great care the applications for loans and not be influenced by the findings made in connection with admission to membership. Such a requirement is found in the Massachusetts and Wisconsin laws. In New York, however, the recently enacted law for credit unions specifically states that this committee may be selected from the membership of the board. The supervisory committee is in general charge of the examining and auditing of accounts. It also represents the association when the latter is not in session. As a rule, all officers serve without pay. The only exception is when a small salary is paid the treasurer or manager.[2]

HOW THE ASSOCIATION HELPS ITS MEMBERS.

A credit association may render service to its members in several ways: First, in furnishing the incentive and facility for saving and local investment; second, in furnishing the advantages of training in business methods and habits; third, in furnishing the opportunity and in giving the assistance necessary to borrow to advantage; fourth, in accumulating a collective fund for common agricultural purposes.

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[1] In some foreign countries the credit associations are affiliated in unions whose functions include the auditing of accounts for the local organizations.

[2] Valuable suggestions as to organization and management of credit unions may be found in the following:

Massachusetts Bank Commissioner. Credit unions. Boston, 1911.

Ham, Arthur H., and *Robinson, Leonard G.* A credit union primer. New York, Russell Sage Foundation, 1914.

THE STIMULATION TO SAVING.

In many communities there is considerable waste, either because funds are permitted to lie idle or because money is spent heedlessly through lack of a suitable incentive for saving. To remedy such evils, it is not only necessary to appreciate the superior advantage of habits of economy, but also to have at hand an agency to which it will seem worth while for the individual to bring his money, rather than to spend it or allow it to lie idle. The credit association furnishes just such an agency conveniently at hand, where a member may come at his convenience and deposit even trifling sums of money. Moreover, such an advantage is not necessarily limited to adults. In a large number of credit unions in Massachusetts, the main purpose of organization has been to establish an institution that would stimulate thrift among children. In some of these unions half of the capital account is held in this way and has been brought together by the accumulation of very small sums of money, until some of these children's deposits amount to as much as $50 or more. In order to offset to some extent the influence of a large number of institutions about us that appeal constantly to the spending habits of young and old, it would seem worth while to supply an agency that appeals to the homelier yet more enduring virtues of thrift and economy. Moreover, it may be added that the advantage of being able to borrow is no advantage at all, unless the individual has first demonstrated some ability to save.

The advantages of such an association ought to be considered from the standpoint of the interest of the community also. Not only is the community's stock of capital enlarged by the increased savings, but the funds are employed locally to build up the community instead of being sent away for the benefit of other regions. In this connection, it should be stated that a cooperative credit association does not displace other banking institutions, but rather tends to supplement and enlarge their work. Its deposits are generally in such small amounts as would not accrue to other banks directly. On the other hand, the funds not loaned to members are deposited with other banks.

THE TRAINING IN BUSINESS METHODS.

Every member of such an association derives important business benefits. He gains the advantage of an open account. This supplies a fund that can be drawn on at any time to meet temporary needs, while the unused balance yields the owner a moderate rate of interest. Again, the farmer is brought into contact with bank statements and accounts and becomes familiar with commercial forms and practices. The use of these improved facilities in exchange also reveals the importance of accuracy and promptness in dealing with credit obligations.

THE SUPERVISION OF LOANS.

The loan service of a credit association is twofold: It affords an opportunity to borrow to advantage and discourages unwise borrowing. A member is able to secure a loan of the desired amount at a reasonable rate and for such a time as may be necessary in view of the purpose of the loan. The work of the credit association also consists to a large extent in so directing the use of the borrowing privilege that it will be applied to productive purposes, and to productive purposes only. In other words, it is the function of such an association to restrain members from contracting unwise loans, as well as to encourage those that are productive. This can be accomplished in the local association, where the members know each other and can watch the uses to which the loans are devoted.

The restraining influence of neighbors' watchfulness is, of course, prompted by the fact that all are financially interested in a safe use of the money. This very watching safeguards the returns of a loan and insures added security to the loan agency.

THE USE OF A COLLECTIVE FUND.

The services already discussed apply more particularly to individual members. Such an association may also be of direct service to the whole group by affording the use of a collective fund for common agricultural purposes. This function has been especially important in certain foreign countries, where collective purchasing is conducted largely with the aid of the credit association. All of these services aid the farmer as a member of a credit association to command confidence that may be denied him as an individual.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

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Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.

COTTONSEED MEAL FOR FEEDING BEEF CATTLE.

By W. F. WARD,

Senior Animal Husbandman in Beef Cattle Investigations, Animal Husbandry Division.

Cottonseed meal is a commodity which has been used for feeding cattle in the South for many years, but it is only within recent years that it has been used generally in the North and West. In the past a very large proportion of the cottonseed meal produced in this country has been exported, and much of that remaining has been used as fertilizer, so that probably less than half of the quantity produced has been used for feeding to cattle. During 1913 there were about 400,000 tons of cottonseed meal exported to Europe. For many years European feeders have shown their appreciation of this product as a feed by purchasing it in this country and paying freight on it to Europe to use for feeding purposes. It is becoming more popular as a supplementary feed in many sections of this country.

Cottonseed meal is one of the most concentrated feedstuffs found upon the market to-day. It contains from 38 to 45 per cent of protein and is therefore very valuable as a nitrogenous feed. Linseed-oil meal is one of the few feeds of vegetable origin which contain near the amount of protein found in cottonseed meal.

Cottonseed meal has a slightly greater feeding value than linseed-oil meal, and, as it is sometimes cheaper than the latter, it is often more profitable to use. At the present time (winter of 1914–15) cottonseed meal is worth about $24 to $28 a ton, which is an unusually low price, while oil meal is selling for about $38 a ton. Feeders should get prices on each of these feeds and use the one which can be bought the more cheaply.

COTTONSEED MEAL FOR CALVES.

Cottonseed meal has not proved to be a good feed for very young calves. Many deaths have resulted where it was fed, and the deaths were usually attributed to the meal. Until more is learned concern-

NOTE.—This bulletin gives the results of experiments in feeding cottonseed meal to beef cattle in varying proportions and offers suggestions for its profitable use. It will be of interest to farmers and cattle raisers generally.

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ing the toxicity of cottonseed meal, it is well to feed it very sparingly and with extreme caution to young calves.

For several years the Bureau of Animal Industry in the course of feeding experiments has fed beef calves ranging from 7 to 10 months of age on cottonseed meal for periods ranging from 100 to 112 days with no ill results. These calves were fed in lots containing from 24 to 52 head each. In no single lot were less than 24 head fed, so there should be practically no difference due to individuality of the animals.[1]

During 1910, 77 grade beef calves were divided into three lots and fed for 119 days. The calves were started on 1 pound of cottonseed meal per day, and the quantity was gradually increased until they consumed 3.67 pounds each per day during the last month. At no time did they receive more than 4 pounds per head per day. The calves of all lots made good daily gains for the entire time, the gains ranging from 1.71 to 1.83 pounds per head. The calves fattened rapidly, and no ill results from feeding cottonseed meal were experienced, although at the end of the test two or three of the calves showed the effects of feeding by a cloudiness of the eyes. The results of the test are summarized in the following table:

Results of experiment in feeding 77 calves, Nov. 17, 1910, to Mar. 17, 1911 (119 days).

Lot No.	Daily ration.	Quantity.	Initial weight of calves.	Total gain.	Average daily gain.	Feed to make 100 pounds of gain.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1	Cottonseed meal	2.84	338	203	1.71	179 cottonseed meal.
	Cottonseed hulls	7.44				435 cottonseed hulls.
	Mixed alfalfa hay	5.39				315 mixed hay.
2	Cottonseed meal, two-thirds	2.34	333	210	1.76	133 cottonseed meal.
	Corn-and-cob meal, one-third	1.17				65 corn-and-cob meal.
	Cottonseed hulls	7.50				425 cottonseed hulls.
	Mixed alfalfa hay	5.47				310 mixed hay.
3	Cottonseed meal, one-third	2.38	328	218	1.83	130 cottonseed meal.
	Corn-and-cob meal, two-thirds	3.87				211 corn-and-cob meal.
	Cottonseed hulls	7.33				400 cottonseed hulls.
	Mixed alfalfa hay	4.00				218 mixed hay.

The same year another lot of 52 calves were fed on cottonseed meal, cottonseed hulls, and mixed cowpea hay. They were fed for 112 days, and during that time they consumed daily 3.08 pounds of cottonseed meal, 10.01 pounds of cottonseed hulls, and 1.5 pounds of mixed cowpea hay. An average daily gain of 1.24 pounds per calf was made. The calves fattened readily, and none showed ill effects from feeding the meal. The results are summarized as follows:

Results of experiment in feeding 52 calves, 1911.

Lot.	Daily ration.	Quantity.	Initial weight of calves.	Total gain.	Average daily gain.	Feed to make 100 pounds of gain.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1	Cottonseed meal	3.08	313	139	1.24	249 cottonseed meal.
	Cottonseed hulls	10.01				808 cottonseed hulls.
	Mixed hay	1.50				121 mixed hay.

[1] See Bureau of Animal Industry Bulletin 147 and Department of Agriculture Bulletin 73.

In 1913–14 another experiment in feeding calves on cottonseed meal was conducted. Forty-nine grade Angus calves, averaging 9 months of age were fed from December 21 to January 17, as a preliminary period to the regular feeding. During this time they were started on a ration of cottonseed meal. The following paragraph is taken from the bulletin reporting the work:[1]

> At the beginning of the test proper, each calf was eating daily 3 pounds of cottonseed meal, approximately 20 pounds of corn silage, and 4 pounds of hay. The allowance of meal was raised gradually throughout the whole period of 76 days, until at the last each calf was eating 6 pounds daily. At one time each calf was consuming as much as 28 pounds of silage each day, but they would not continue to eat this much, so at the end of the period (Apr. 1) they were eating an average of only 20 pounds per calf per day. The allowance of hay was gradually decreased from the first. At the middle of the period each calf consumed daily not over 3 pounds of hay, and near the end an exceedingly small allowance met their desires. From the middle of March to April 1 they averaged less than 1 pound of hay per calf per day.

These calves consumed on the average 4.4 pounds of cottonseed meal per day for 76 days, and were eating about 6 pounds of cottonseed meal during the latter part of the feeding period, but no ill results were experienced.

The following summary gives the daily ration, the initial weight of the calves, the daily gain, and the amount of feed required to make 100 pounds gain.

Results of experiment in feeding 49 calves, 1913–14.

Lot.	Daily ration.	Quantity.	Initial weight of calves.	Total gain.	Average daily gain.	Feed to make 100 pounds of gain.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1	Cottonseed meal	4.4	456	104	1.37	323 cottonseed meal.
	Corn silage	23.9				1,741 corn silage.
	Hay	2.76				201 hay.

COTTONSEED MEAL FOR THE BREEDING HERD.

It is not advisable to feed bulls on large quantities of cottonseed meal for long periods, as the opinion prevails among many stockmen that it impairs the breeding powers of the animal. It can be fed to them in reasonable quantities throughout the winter, however, with little danger. From 2 to 3 pounds of cottonseed meal may be fed daily along with some other feeds, such as crushed corn, bran, corn silage, and some good hay.

For feeding to breeding cows there is no feed which equals cottonseed meal in small quantities. The breeding herd can be wintered very economically by feeding about 2 pounds of cottonseed meal per head per day with some silage, stover, and other farm roughage.

[1] Department of Agriculture Bulletin 73.

In 1912 a large herd of breeding cows were wintered in Mississippi by feeding them 2 pounds of cottonseed cake per day, with all the oat straw they would consume and what roughage they got from the old corn and cotton fields. The cattle were wintered very economically, as they were fed but three and one-half months, and they were in good condition when spring came. In one experiment in Alabama [1] the cows were permitted to run in the stalk fields and in a small canebrake all winter, and from January 23 to May 7 they were given about 2 pounds of cottonseed cake per day. They were in fair condition when spring came and had been wintered very economically.

Throughout Virginia, Maryland, and parts of the corn belt the cows may be run in the stalk fields until about November 15, when they should be taken up and fed about 2 to 2½ pounds of cottonseed meal per day, 15 to 30 pounds of corn silage, depending upon the amount available, and what other roughages they will eat, such as corn stover, hay, and straw. In sections where losses have occurred from cornstalk disease, the practice of turning cattle into the stalk fields should not be followed. If there is no silage, a small quantity of corn may be used with the cottonseed meal and the other farm roughages. A pound of cottonseed meal is usually worth about 2 pounds of corn, so a farmer can readily calculate which will be the more profitable feed.

FOR STOCKER CATTLE.

There are few combinations of feed which are more economical than a ration of corn silage and cottonseed meal for wintering stocker cattle. Two pounds of cottonseed meal, combined with what corn silage stocker steers will eat, will cause them to gain slightly in weight. The cost of wintering such cattle can usually be lessened by permitting the steers to run in the stalk fields and giving feed at night only. Straw and other roughages which can not be used to advantage in any other way may be fed with the silage and cottonseed meal. If it is desired to make the steers gain in weight throughout the winter, preparatory to fattening on grass during the summer, the ration of cottonseed meal may be increased.

The Bureau of Animal Industry, in cooperation with the Alabama experiment station, conducted tests in wintering steers during three winters from 1907 to 1910.[2] Each year one lot of steers was permitted to range in the old cotton and cornstalk fields and over some waste land, while a second lot ran on similar range, but received in addition a small ration of cottonseed meal and cottonseed hulls. The results are given in the following table:

[1] Department of Agriculture Bulletin 73.

[2] See Bureau of Animal Industry Bulletin 131 and Department of Agriculture Bulletin 110.

Results of experiments in feeding steers during three winters.

WINTER OF 1907–8 (84 DAYS).

Lot.	Daily ration.	Average initial weight per steer.	Average gain (+) or loss (−) of each steer.	Average daily gain (+) or loss (−) of each steer.
		Pounds.	*Pounds.*	*Pounds.*
1	Range alone	722	−97	−1.15
2	Range plus 2.35 pounds cottonseed meal and 8.5 pounds cottonseed hulls	726	− 6	− .07
	WINTER OF 1908–9 (98 DAYS).			
1	Range alone	705	−106	−1.08
2	Range plus 2.41 pounds cottonseed meal and 8.71 pounds cottonseed hulls	705	+ 3	+ .03
	WINTER OF 1909–10 (91 DAYS).			
1	Range alone	637	−106	−1.16
2	Range plus 2.4 pounds cottonseed meal and 8.9 pounds cottonseed hulls	633	+ 43	+ .47

When the cattle got no feed except stalk fields they lost about 103 pounds per head each winter, while the steers which received 2.4 pounds of cottonseed meal and 8.7 pounds of cottonseed hulls in addition to the range held their own throughout the winter and weighed as much in the spring as they did at the beginning of winter.

COTTONSEED MEAL FOR FATTENING MATURE CATTLE.

The fattening of mature cattle on cottonseed meal and cottonseed hulls has been practiced in the South for many years. Formerly the cattle were fed in large numbers near oil mills, and the steers were fed very heavily on the by-products. Steers were frequently fed as much as 12 to 15 pounds of cottonseed meal per head a day. As a result of such heavy feeding, many became blind, exhibiting a staggering gait, and occasionally swelled in the legs below the hocks. Some would die, while others would cease gaining in weight, go off feed, and then rapidly lose flesh. Even though the feed was changed, much trouble was experienced in getting the animals back to a normal appetite and a thrifty condition.

When steers are not fed over 7 pounds of cottonseed meal a day they can usually be fed for 100 to 120 days without showing any signs of cottonseed-meal sickness. If silage or other succulent feed is given as roughage the meal can be fed much longer without harmful results.

When cattle are fed a ration composed of cottonseed hulls and meal alone they usually make exceedingly good daily gains for the first 60 days, after which time the gains begin to diminish rapidly,

and unsatisfactory gains are usually secured after 90 to 100 days. For a short feeding period cottonseed hulls and meal give satisfactory results. If the roughage is silage instead of hulls the daily gains are more uniform throughout the feeding period; and if care is used in feeding the meal can be fed for 150 days without ill effects.

The Bureau of Animal Industry has conducted experiments in cattle feeding continuously since 1904, and the results bear out the statements given above. Feeding done by Curtis, of the North Carolina agricultural experiment station,[1] also emphasizes the statements regarding the daily gains of cattle fed on cottonseed meal with hulls or silage as the roughage.

With the prices of cottonseed meal such as have prevailed during the last few years, the heavy feeding of this meal has proved uneconomical.

In a number of experiments made at the North Carolina station, where steers were fed different quantities of cottonseed meal, those that received 9 pounds a day made slightly larger daily gains than those getting smaller quantities, but the gains were much more expensive, and the profit was smaller.[2] Similar results were secured in several tests conducted by the West Tennessee experiment station.[3] Greater profit was made on steers which were fed from 5 to 7 pounds of cottonseed meal a day than on steers which were fed 7 to 9 pounds a day. The feeding of cottonseed meal with silage gave larger daily gains, cheaper gains, better finish, and more profit than feeding cottonseed meal with hulls.

The Indiana experiment station found that the average Indiana rations could be greatly improved by the addition of 2½ pounds of cottonseed meal for each steer daily.[4] The addition of cottonseed meal to a ration containing clover hay resulted in increased gains, more economical gains, and a greater profit. Cottonseed meal proved to be better for balancing a ration than soy-bean meal, as the latter had a laxative tendency.[5] The steers would not eat as much feed, made smaller daily gains, and did not sell as well when soy-bean meal replaced the cottonseed meal in a ration of shelled corn, cottonseed meal, oat straw, and corn silage.

The addition of cottonseed meal to rations of shelled corn and clover hay, and shelled corn, clover hay, and silage, resulted in more feed being consumed, as the cottonseed meal did not decrease the quantity of other feeds consumed, but acted as a stimulant.[6]

The analysis of cottonseed meal indicates it to be superior to linseed meal, and some feeders consider it so, but tests made at the

[1] North Carolina Station Bulletins 219 and 222.
[2] North Carolina Station Bulletin 222.
[3] Tennessee Station Bulletin 104.
[4] Indiana Station Bulletins 129 and 136.
[5] Indiana Station Bulletin 167.
[6] Indiana Station Bulletin 129.

Nebraska experiment station indicated that there was little difference in feeding value, the slight difference being in favor of linseed meal.[1]

COTTONSEED MEAL OR CAKE FOR PASTURE FEEDING.

For years feeders of the Southwest have used cottonseed cake for feeding to steers on pasture in the fall and early winter and at times when the grass was covered with snow. The fattening of cattle on grass with cottonseed cake during the spring and summer months had not been practiced to any extent when the Bureau of Animal Industry started some tests to determine whether such feeding would be profitable.[2] These feeding experiments have been conducted for seven years with large numbers of cattle each year. In most cases each lot of cattle consisted of one or more carloads. Cottonseed cake was always fed in preference to the meal. It was broken into nut size and sacked at the mill. In regard to feeding cake in preference to meal, a former publication of the bureau is here quoted:

> This cake can be purchased in the large cake size, just as it comes from the press, for about $2 per ton cheaper than in the nut size. Some feeders find that it pays to break the cake on their farms. The cake is the same as cottonseed meal except that it is not ground into meal. There are several advantages in feeding cake in place of meal, especially in summer feeding. A rain does not render the cake unpalatable, but it will often put the meal in such a condition that the cattle will not eat it. Again, no loss is incurred with the cake during windy days, whereas the meal, when fed in the open pasture, is sometimes wasted on account of the winds. Furthermore, the cake requires chewing before being swallowed and therefore must be eaten very much slower than the meal, so when a number of steers are being fed together the greedy one has little chance to get enough cake to produce scours. When cottonseed meal is fed the greedy steer often scours because he can bolt the meal and get more than his share; this not only injures the steer, but makes the bunch "feed out" unevenly.

The cake was fed in troughs in the pasture. The steers were started with a ration of 1½ pounds per head per day, and the quantity was gradually increased until the thirty-fifth day when they were eating 5 pounds per day. Some steers did not take readily to cottonseed cake and had to be coaxed into eating it by sprinkling a very little salt over it and withholding salt at other times. After they once began eating cake there was no further trouble, as they ate it greedily.

Each year one lot of cattle was grazed without additional feed, while another lot was grazed and in addition received a supplemental ration of cottonseed cake. Several years' work tends to show conclusively that the feeding of cottonseed cake to cattle on pasture caused the cattle to gain in weight faster, to fatten more rapidly, to develop greater "bloom," and to make greater profits than similar

[1] Nebraska Station Bulletin 100.

[2] See Bureau of Animal Industry Bulletins 131 and 159 and Department of Agriculture Bulletin 110.

cattle which received pasturage alone. Persons desiring further information on this subject should consult Bureau of Animal Industry Bulletins 131 and 159 and Department of Agriculture Bulletin 110.[1]

SUMMARY.

In conclusion, it would be well for feeders to bear in mind the following points:

(1) Do not feed young calves heavily on cottonseed meal.

(2) Secure prices on both cottonseed meal and linseed meal and use the cheaper feed.

(3) If cottonseed meal does not cost over $34 a ton it can probably be used to advantage in wintering the breeding herd.

(4) By feeding a ration of 2 pounds of cottonseed cake with corn silage, or 2½ pounds of cottonseed cake with coarse roughages such as oat straw, corn stover, etc., mature cattle can be wintered very economically.

(5) One pound of cottonseed meal is usually worth as much as 2 pounds of corn for feeding cattle.

(6) In sections where much corn, stover, fodder, timothy, or other carbohydrate feeds are used, it is extremely important that some feed like cottonseed meal be used.

(7) Cottonseed meal stimulates the appetite of fattening animals and causes them to consume more feed and likewise to make greater gains.

(8) Heavy feeding of cottonseed meal should be discontinued after 100 to 120 days where dry roughage is fed and after 150 days where succulent feeds are used.

(9) Cottonseed cake can be used very profitably as a supplemental feed for fattening cattle on pasture.

(10) Five times as many farmers should be using cottonseed meal as are doing so at the present time. Are you one of them?

[1] These bulletins may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each for the first two and 5 cents for the last.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1915

UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 656 APRIL 6, 1915.

Contribution from the Office of Markets and Rural Organization, Charles J. Brand, Chief.

THE COMMUNITY EGG CIRCLE.

By C. E. BASSETT, *Specialist in Cooperative Organization*, and W. H. KERR, *Investigator in Market Business Practice.*

MARKETING THE EGG CROP.

When it is estimated that the annual production of poultry and eggs in the United States is in excess of $600,000,000—equal to the value of the hay or the wheat crop—and when it is estimated that there is a total loss of nearly 8 per cent of the eggs marketed,[1] the importance of this subject is evident.

This great loss is due largely to improper handling between the farm and the market. Most farmers look upon eggs as a by-product, and the returns as so much clear gain. The hens forage for a living, eggs are gathered when convenient and kept almost anywhere. With such carelessness and a combination of mongrel stock, dirty nests, stolen nests of broody hens, unconfined males, late maturing pullets, and other undesirable conditions, is it any wonder that the product includes such a high percentage of small, cracked, dirty, stale, heated, and even rotten eggs?

Occasionally the accumulations of all these kinds of eggs are taken to the country merchants and exchanged for merchandise. The merchant usually buys these eggs "case count," paying the same price for all kinds and sizes, provided they are eggs with an unbroken shell. Small production results in small or infrequent shipments.

[1] Pennington, M. E., and Pierce, H. C.—"The effect of the present method of handling eggs on the industry and on the product." In Yearbook of the U. S. Department of Agriculture, 1910.

NOTE.—Intended for all farmers who would be interested in the formation of a community circle for the marketing of eggs. It would be of especial interest at this time to farmers in the cotton belt who desire to diversify their farming because of the economic crisis which adversely affects the cotton crop at present.

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REMEDIES.

Many of these losses can be prevented by:[1]

(*a*) Selecting pure breeds that lay more and larger eggs, such as the White Leghorns, Wyandottes, Plymouth Rocks, Rhode Island Reds, Orpingtons, etc.
(*b*) Giving better care, food, and shelter, with dry, clean, vermin-proof nests.
(*c*) Confining males except in breeding season.
(*d*) Collecting eggs frequently, especially in hot or muggy weather.
(*e*) Storing eggs in a dry, clean, cool place.
(*f*) Using small and dirty eggs at home.
(*g*) Marketing frequently, with protection at all times from heat.
(*h*) Selling for cash on a basis of size and quality, "loss off" instead of "case count."
(*i*) Using an attractive package.
(*j*) Combining shipments as a matter of economy.

COOPERATIVE MARKETING.

By uniting several egg producers in an association more can be accomplished in these essentials. One very successful egg company has a large incubator house with 12,000 eggs capacity, where early chicks are produced for the members at a low cost. This is done in order to obtain early maturing pullets, thus securing eggs during the fall, when eggs are usually scarce. The company also has a receiving room for eggs where they are candled, sorted to weight (about 24 ounces to the dozen), packed in cartons, and shipped on contract orders. Their eggs are all guaranteed to be according to grade, they advertise the fancy grades on their cartons and cases, and market prices are paid to the members. Twice a year dividends are paid each member in proportion to the amount of eggs marketed through the company and the time of year eggs were brought in, a larger dividend being paid per dozen for eggs brought in during the fall and winter than for those brought in during the spring and summer, estimated by months. A regular trade is established with discriminating consumers, with city clubs, with the best class of hotels and restaurants, and with fancy grocers for a supply each day or week.

The reputation thus established enables this association to fix its price at several cents per dozen above the regular market quotations, as fancy trade is willing to pay a premium for a guaranteed article. Most egg circles cooperate in buying their chicken feed and other poultry supplies.

ATTRACTIVE PACKAGE.

All food products should be delivered in a clean, attractive package. Some of the most successful egg shippers have discarded the dirty wooden case and are using a heavy fiber-board gift case, which will hold from 15 to 30 pasteboard cartons. Each carton has compartments for 12 eggs. Upon both the cartons and the case can be

[1] Farmers' Bulletin No. 528—Hints to poultry raisers, by Harry M. Lamon, of the Animal Husbandry Division, Bureau of Animal Industry.

printed such advertising as may be wished. This style of package is especially desirable for the fancy retail grocer who can have his firm name included in the advertising. The fiber-board case is not expensive, forms a good protection to the eggs in shipping, and is worthy of trial.

MARKETING BY PARCEL POST.

With a firm container, parcel post can be used for small shipments to private homes within first and second zones; that is, 150 miles. Each egg should be wrapped in paper to hold it snugly on end, in its own individual compartment of the container, so that it has no play; and after the container is closed it should be securely wrapped in strong wrapping paper and tied with coarse strong cord.[1]

MARKETING THROUGH THE CREAMERY.

Where there is a successful creamery established in the neighborhood, eggs can be delivered to it with the cream or milk. Creamery officials can often work up a fancy trade with those who buy the butter. Marketing through the creamery has been very successful.[2]

ORGANIZING THE CIRCLE.

The following forms are offered as aids in organizing, managing, and auditing a community cooperative egg circle or association. They are subject to such changes as will make them best adapted to the local conditions.

While at first the number of eggs to be marketed may not warrant a central station, with a manager to inspect, grade, and market the whole product, the aim should be to develop to that state. It is the only way to secure a uniform grade, which will attract the highest class of trade.

PRELIMINARY AGREEMENT.

We, the undersigned, citizens of ..... County, State of ....., do hereby agree to form ourselves into an association, to be known as the ..... Egg Circle, and agree to abide by the rules for the conduct of the business which may be adopted by a majority of the members in regular session.

Name.	Address.	Number of hens kept.

[1] For further information see Farmers' Bulletin No. 594, "Shipping eggs by parcel post," by Lewis B. Flohr, of the Office of Markets and Rural Organization.

[2] Farmers' Bulletin No. 445, "Marketing eggs through the creamery," by Rob R. Slocum of the Bureau of Animal Industry.

CONSTITUTION.

ARTICLE 1.—*Name.*

The name of this association shall be the ..... Egg Circle and its place of business shall be at .....

ARTICLE 2.—*Objects.*

The objects shall be to secure and improve better strains of poultry; to produce more eggs of good color and size; to handle eggs more carefully in order to avoid waste; to pack a uniform grade of clean, fresh eggs, in order to be able to guarantee them and thus create a reputation; to market same more directly to the consumers; to purchase supplies in a cooperative way, and to do such other things as may prove of benefit to the members and the community.

ARTICLE 3.—*Officers.*

The officers of the circle shall be a president, vice president, secretary-treasurer, and two trustees, the five to constitute a board of managers. They shall be elected at the regular annual meeting, to be held on the second Monday in January of each year and they shall serve one year or until their successors are elected.

ARTICLE 4.—*Duties of officers.*

The officers shall perform the usual duties connected with their several offices. Unless the board of managers elects a manager, the secretary-treasurer shall act as manager, and, in addition to keeping all records, shall have charge of the buying of all supplies; the collecting, inspecting, grading, and packing of the eggs; the securing of orders from the most profitable class of customers (such as first-class hotels, restaurants, and private trade); the making of all shipments and collecting of accounts, settling with all members on the same basis for the same class of eggs.

The manager shall give a bond in twice the sum that he is liable to handle at any one time, the cost of said bond to be paid for by the circle. He shall keep a careful account and record of all money transactions, which account shall be inspected and audited not less than once in each three months by two competent persons, with a yearly audit just before the annual meeting, the report of such audit to be made in writing to said annual meeting.

ARTICLE 5.—*Membership.*

Any person may become a member of this circle by paying the annual fee of $1 and agreeing to live up to the rules of the circle.

ARTICLE 6.—*Voting.*

Any member in good standing shall be entitled to cast one vote at any meeting of the circle, but no proxies shall be allowed.

ARTICLE 7.—*Amendments.*

This constitution may be amended at any annual meeting or at any special meeting called for that purpose, provided that two-thirds of all members present vote for such change; and provided further that at least 10 days' notice of such proposed amendment shall have been given the members.

BY-LAWS.

1. Members must deliver to the circle all eggs produced by their hens, except those for home use, and those from stolen nests of unknown age.

2. Eggs must be gathered daily (twice daily in hot or muggy weather) and kept in a cold place. No eggs older than 7 days shall be delivered to the collector. Artificial

eggs only may be used as nest eggs, and the nests must be kept clean. Broody hens must be confined away from nesting places.

3. Members may deliver eggs to the circle only from their own hens.

4. The manager shall have power to pay a higher price for white or brown shelled eggs, according to the demands of the market.[1] Eggs that do not average 24 ounces to the dozen shall be paid for by weight on the above basis.

5. With the exception of during the mating season, all male birds must be kept apart from the flock of hens. The manager shall have power to pay a small premium for these infertile eggs, if the market warrants.

6. The manager may refuse to accept "dirties." If accepted, they shall be taken at a discount. Eggs must not be cleaned.

(If each member is permitted to pack the eggs, the following by-law applies:)

7. Each member shall receive a rubber stamp, giving the brand of the circle and the recorded number of the member. Each egg must be stamped plainly and neatly on the big end. Only fresh, clean eggs of standard weight, and uniform color may be packed in the cartons, holding a dozen each, the cartons being furnished by the circle, and the member's stamp also being placed on the face of the carton. In case any complaint is received in regard to any eggs, the member whose stamp is on the eggs shall be charged with any expense of settlement made necessary by his carelessness.

(If the eggs are brought to a central house for packing, the following by-law applies:)

8. All eggs shall be collected and delivered to the circle packing house by such means as the annual meeting may determine. Each member shall be given a receipt for the number of eggs he delivers. These eggs shall be candled, graded, and packed by the manager or his assistants and each member be given credit for the number of each grade. All eggs of the same grade shall then be pooled, and when sold payment shall be made on the basis of the price received for each grade, less all necessary expenses.

9. The manager shall be paid a commission of .. per cent on the net sales of the business, not to exceed a total amount of $..... per year.

10. Any member failing to live up to these by-laws may be expelled from membership or sufficient sum withheld from his sales to reimburse the circle for any loss occasioned by his failure. In all such cases the member shall first have the right to be heard before the board of managers.

11. Members may voluntarily withdraw from the circle, to take effect only at the end of the business year, by giving 30 days' notice to the manager.

COMMUNITY EGG CIRCLE RECEIPT FORMS.

INSTRUCTIONS FOR PRINTING AND BINDING.

Forms A, B, and C should be numbered in triplicate. Form A (original) should be printed on white paper, Form B (duplicate) and Form C (triplicate) on paper of different tints, preferably light bond, and bound in books of 25 numbers to the book. Forms B and C should be perforated.

[1] New York and Chicago markets will often pay several cents a dozen more for white-shelled eggs, while Boston prefers the brown-shelled eggs. It is a case of market preference.

INSTRUCTIONS FOR USE.

The collector enters the total number of eggs received from a member in the spaces provided on Form A, using carbon sheets so that the date, member's name, circle number, and number of dozen eggs collected are given on all three forms. The collector, at the time of collection, delivers Form C to the member, which is a receipt for the number of eggs delivered to the collector.

At the end of the day the book containing the original and duplicate copies, Forms A and B, is turned in at the office.

As the eggs are candled and graded the number of dozens of each grade is placed upon Form A by the grader, the same information being shown on the carbon, or Form B. This then gives the member the proper credit for the number of dozens of each grade delivered.

Settlement is made for each pool or delivery, which in most cases will be covered by one receipt for each member. As returns for the shipments are received the amount due each member will be carried out in the price and total columns of Forms A and B. Check is then drawn for the amount due and forwarded to the member with Form B, which gives a statement of returns and a duplicate of the receipt which the member holds with the additional information of the grading and amount received for each grade. Form A remains in the book and is kept on file in the office to serve as a permanent record of settlements with the producer.

FORMS.

(Form A.)

Folio .... No. ....

FARMVILLE POULTRY CIRCLE, FARMVILLE, VA.

Office copy of member's receipt.

Date, ..., 191...

Received of .... Circle No. .. the following:

	No.	Price.	Total.

Paid by check No. .....
Date ....., 191...

Checked by ....
Collector ....

(Form B.)

No. ....

FARMVILLE POULTRY CIRCLE, FARMVILLE, VA.

Statement of returns and copy of member's receipt.

Date collected, ..., 191...

Mr. ...., Circle No. .... the inclosed check is in payment of the following:

	No.	Price.	Total.
Less.....			
Total of check.....			

Checked by ....
Collector ....
Manager ....

(Form C.)

No. ....

FARMVILLE POULTRY CIRCLE, FARMVILLE, VA.

Member's receipt.

Date ....., 191...

Received of ...., Circle No. .... the following:

Collector ....

To MEMBER: Keep this receipt and compare with monthly statement sent you by Circle office.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 657 MAY 6, 1915.

Contribution from the Bureau of Entomology, L. O. Howard, Chief.

THE CHINCH BUG.[1]

By F. M. WEBSTER,

In Charge of Cereal and Forage Insect Investigations.

INTRODUCTION.

Few insects, and certainly no other species of the natural order to which this one belongs, have been the direct cause of such enormous pecuniary losses as the chinch bug (fig. 1). No other insect native to the Western Hemisphere has spread its devastating hordes over a wider area of country (see maps, figs. 6 and 7) with more fatal effects to the staple grains of North America than has this one. Were it not for the extreme susceptibility of the very young to destruction by drenching rains, and the less, though not insignificant, fatalities to both the adults and young during rainy seasons attributed to the parasitic fungus *Sporotrichum globuliferum* Speg., the practice of raising grain year after year on the same areas, as is followed in some parts of the United States, would become altogether unprofitable. Some of this insect's own habits, emphasizing as they do the effects of weather conditions, are among the most potent influences that serve to hold it within bounds by giving its tendency to excessive increase a decidedly spasmodic character.

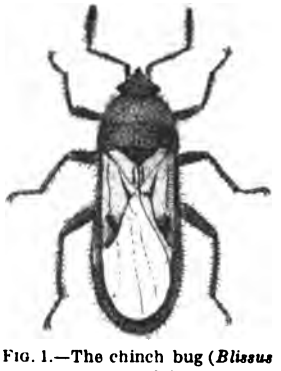

FIG. 1.—The chinch bug (*Blissus leucopterus*): Adult of long-winged form, much enlarged. (Author's illustration.)

[1] *Blissus leucopterus* Say; order Hemiptera, family Lygæidæ.

NOTE.—This bulletin describes the forms and stages of the chinch bug, its habits and natural enemies, and suggests methods of preventing its ravages. It will be of general interest wherever this pest prevails.

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DESCRIPTIONS OF THE DIFFERENT STAGES.

THE EGG.

The average length of the chinch bug's egg (fig. 3, *a*, *b*) is three one-hundredths of an inch. In shape it is elongate-oval, the diameter being scarcely one-fifth the length. The top is squarely docked and surmounted with four small, rounded tubercles near the center. When

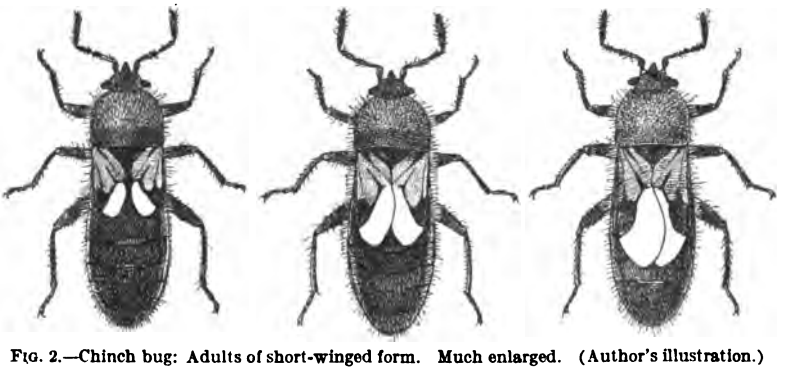

FIG. 2.—Chinch bug: Adults of short-winged form. Much enlarged. (Author's illustration.)

newly deposited the egg is pale or whitish and translucent, but with age it acquires an amber color and finally shows the red parts of the embryo within, especially the eyes toward the tubercled end. The size increases somewhat after deposition, and the length will sometimes reach nearly four one-hundredths of an inch.

THE LARVAL, OR NYMPHAL, STAGES.

The newly hatched larva, or nymph (fig. 3, *c*, *d*), is pale yellow, with simply an orange stain on the middle of the three larger abdominal joints. The form scarcely differs from that of the mature bug, being but slightly more elongate; but the tarsi have only two joints, and the head is relatively broader and more rounded, while the joints of the body are subequal, the prothoracic joint being but slightly longer than any of the rest. The red color soon pervades the whole body, except the first two abdominal joints, which remain yellowish, and the legs and antennæ, which remain pale.

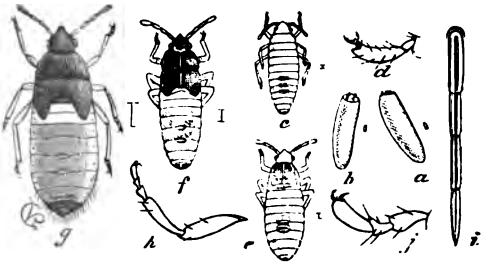

FIG. 3.—The chinch bug: *a*, *b*, Eggs; *c*, newly hatched larva, or nymph; *d*, its tarsus; *e*, larva after first molt; *f*, same after second molt; *g*, last-stage larva; the natural sizes indicated at sides; *h*, enlarged leg of perfect bug; *j*, tarsus of same, still more enlarged; *i*, proboscis or beak, enlarged. (From Riley.)

After the first molt (fig. 3, *e*) the red becomes bright vermilion, contrasting strongly with the pale band across the middle of the

body; the prothoracic joint is relatively longer, and the metathoracic shorter. The head and prothorax are dusky coriaceous; two broad marks on the mesothorax, two smaller ones on the metathorax, two on the fourth and fifth abdominal sutures, and one at the tip of the abdomen, are generally visible, but sometimes obsolete; the third and fourth joints of the antennæ are dusky, but the legs are still pale. After the second molt (fig. 3, *f*) the head and thorax are quite dusky; the abdomen duller red, but the pale transverse band is still distinct; the wing pads become apparent; the members are more dusky; there is a dark-red shade on the fourth and fifth abdominal joints, and ventrally a distinct circular dusky spot covering the last three joints.

In the last-stage larva or nymph (fig. 3, *g*), sometimes called the "pupa," all the coriaceous parts are brown-black, the wing pads extend almost across the two pale abdominal joints, which are now more dingy, while the general color of the abdomen is dingy gray; the body above is slightly pubescent, the members are colored as in the mature bug, the three-jointed tarsus is foreshadowed, and the dark horny spots at the tip of the abdomen, both above and below, are larger.

THE ADULT FORMS.

There are two forms of the fully developed insect, but it is not known that the young of these two forms differ in any respect. One of these forms, the one originally described, is known as the long-winged form and is the only form that occurs over most of the country between the Rocky Mountains and the Allegheny Mountains. This form is illustrated in figure 1.

The second form is much like the first, with the exception of the wings, which are more or less abbreviated, as shown in figure 2. This form occurs along the seacoasts, and in the East extends inland along the lower lakes to northern Illinois. It is not abundant, however, west of a line drawn from Toledo, Ohio, to Pittsburgh, Pa. Throughout the territory in which this short-winged form is found there are also intermingled with them individuals of the long-winged form.

Both of these forms may be described as black, with numerous hairs, also black; the upper wings are whitish, with a black spot on each, and the under wings are white. They are about one-fifth of an inch or less in length and may be easily recognized by the accompanying illustrations (figs, 1, 2, 3, *h*, *i*, *j*).

SEASONAL HISTORY.

Over the territory covered by the long-winged form, as previously given, the insect has two generations each year. The young of the first generation appear in May and June, and those of the second generation in August and perhaps as late as September. The adult

insects (figs. 1, 2) pass the winter among clumps of broom sedge,[1] and where this does not occur in sufficient abundance, among matted grass, fallen leaves, and other rubbish, coming forth from hiding in spring, spreading to the grain fields, where they deposit their eggs, and dying soon afterwards. The young (fig. 3, *c*) hatching from these eggs cluster upon the plants and begin at once to feed upon the juices. Figure 4 illustrates a corn plant with the chinch bugs clustering upon it. The egg-laying season extends over a considerable period, and

FIG. 4.—Corn plant 2 feet tall infested with chinch bugs. (Author's illustration.)

chinch bugs of all ages, sizes, and colors may be found intermingled. By midsummer the majority of the first generation have reached the adult stage, soon after which the eggs are deposited for the second generation, nearly all individuals reaching their full development by late fall or early winter. This second generation develops and matures on corn, millet, kafir, and similar crops.

It must be remembered that each female of the species is capable of laying from 1 to 500 eggs, and she will scatter them during a period

[1] *Andropogon* spp.

of from two to three weeks. The time required for the eggs to hatch is from about ten days to three weeks, and it requires about forty days for the young to become fully developed after hatching from the egg.

In the eastern portion of the country, where the short-winged form (fig. 2) prevails, it is not certain that there is more than a single generation annually. This short-winged form differs very greatly in its habits from the long-winged form, the first passing the winter in the meadows, which it usually attacks in preference to grain fields, whereas during the period known as the Indian summer the developed bugs of the long-winged form (fig. 1) may be observed flying about, evidently searching for winter quarters. With the short-winged form these migrations to and from the places of hibernation are impossible, the insects being totally incapable of flying. A hint of this peculiarity may be witnessed in the case of the exclusively long-winged form of the first generation, for in migrating from one field to another, even though fully half of the individuals may have developed wings ample for flight, they often travel on foot with the young, even going considerable distances from one field to another. If, however, an artificial barrier is interposed in their path, the winged adults appear suddenly to find out that they have another and more efficient mode of travel, and fly over these obstructions.

Throughout the Middle West, then, where this insect does its greatest injury, crops suffer from two attacks annually, although the later one is not always noticed. It must be remembered, however, that, although attracting little or no attention, this later attack is of the utmost importance, for if there are but few of the second generation developing to adults, there can be no serious outbreak the following spring. If, on the other hand, there are enormous numbers of adults developing in the fall and going into winter quarters, there is a probability that, with weather during spring favorable for their development, there will be an excessive abundance the following year.

HIBERNATION.

While the matter of winter quarters has been previously mentioned in a general way, the winter habit of the pest is of such importance that this phase of its life history is deserving of full explanation. Again and again serious destructive outbreaks of the pest in wheat fields have been traced directly to the influence of shocks of corn fodder allowed to stand in the fields throughout the winter. The chinch bugs which flocked to these corn shocks the previous autumn, suitable quarters not being available elsewhere, were thus protected throughout the winter, migrated from the shocks in the spring, and spread over the wheat field. In other cases destructive out-

breaks have been traced directly to woodlands bordering upon the fields (see fig. 5), the chinch bugs beginning their destruction along the margins of the fields nearest to the woodlands, having passed the winter among the fallen leaves or among such clumps of broom sedge as had grown up among the trees and brush. So, too, have destructive outbreaks in the Middle West been traced to the matted grass and fallen leaves bordering hedges of Osage orange by roadsides and elsewhere. The farmer must understand that it is to such places as these that the chinch bugs flock in the fall, and whatever measures he can apply to prevent them from wintering about his fields will be

FIG. 5.—A road between two farms, with neglected hedges on either side affording ample protection for destructive insects during winter. (Author's illustration.)

just so much protection to his crop from attacks of their offspring during the following year.

In the timothy meadows of New England, New York, and northern Ohio these conditions are of less importance, because there the insects pass the winter largely in the meadows and can not migrate to or from these places, except on foot.

Chinch bugs will stand almost any degree of cold, provided it is continuous and they are fairly well protected from sudden changes. And the farmer may be able to take advantage of their hibernation to deal disastrous blows against their occurrence in his fields during the following spring and early summer.

FOOD PLANTS.

Over the western country the major portion of the damage is to grain fields, including corn and also such forage crops as millet, Hungarian grass, and the nonsaccharin sorghums, the outbreak generally originating in wheat, rye, or barley fields and the bugs migrating at harvest to the cornfields. In the eastern part of the country, where the timothy meadows are the most seriously infested, this is not the case, and here the migrations are as likely, or even more so, to be to the timothy meadows as to the fields of corn where both are equally within reach. Oats are not liable to infestation. The chinch bugs attack sugar cane in Mexico, according to Mr. Albert Koebele. They are known to attack the following grasses: Forked beard-grass,[1] broom beard-grass,[2] oat-grass,[3] bur-grass,[4] millet, witch grass,[5] barnyard grass,[6] *Phragmites* sp.?, sorghum, kafir, large crab-grass,[7] timothy, yellow foxtail,[8] green foxtail grass,[9] Bermuda grass,[10] and what is locally known in Florida as St. Augustine grass. Prof. Lawrence Bruner has also found it feeding upon so-called buckwheat.[11]

It will thus be seen that the insect has an ample food supply outside of the cultivated fields.

LOSSES CAUSED BY CHINCH BUGS.

It would appear that this pest first made its presence known by its ravages in the wheat fields of North Carolina farmers; for we are told that "in 1785 the fields were so overrun with them as to threaten a total destruction of the grain. * * * And at length the crops were so destroyed in some districts that they (the farmers) were obliged to wholly abandon the sowing of wheat. It was four or five years that they continued so numerous, at this time."[12]

In the year 1809, as stated by Mr. J. W. Jefferys[13] the chinch bug again became destructive in North Carolina to such an extent that in Orange County farmers were obliged to suspend the sowing of wheat for two years. In 1839[14] the pest again became destructive

[1] *Andropogon furcatus.*
[2] *Andropogon scoparius.*
[3] *Arrhenatherum sp.*
[4] *Cenchrus tribuloides.*
[5] *Panicum capillare.*
[6] *Panicum crus-galli.*
[7] *Syntherisma sanguinalis.*
[8] *Ixophorus glaucus.*
[9] *Ixophorus viridis.*
[10] *Capriola dactylon.*
[11] *Polygonum dumetorum or P. convolvulus.*
[12] Webster, Noah. A brief history of epidemic and pestilential diseases, v. 1, p. 279. Hartford, 1799. Quoted in Fitch, Asa. [First] Report on the Noxious, Beneficial, and other Insects of the State of New York, p. 279. Albany, 1855.
[13] Jeffreys, J. W. Chinch bug. *In* The Cultivator, Albany, v. 6, no. 12, p. 200-201, Dec., 1839.
[14] Gibbes, W. S. The season, crops and insects in South-Carolina. *In* The Cultivator, Albany, v. 6, no. 6, p. 103-104, August, 1839.

in the Carolinas and in Virginia, where the bugs migrated from the wheat fields at harvest to the corn, and in 1840 there was a similar outbreak, and both wheat and corn were seriously injured. In all of these cases, however, there is no recorded estimate of the actual financial losses resulting from the attacks of the chinch bug. According to Le Baron during the years from 1845 to 1850 the insect ravaged Illinois and portions of Indiana and Wisconsin, and in 1854 and 1855 it again worked serious injury in northern Illinois. The writer's earliest recollection of the chinch bug and its ravages in the grain fields of the settlers on the prairies dates from this last outbreak. Mr. B. D. Walsh estimated the loss to the farmers of Illinois in 1850 at $4,000,000, or $4.70 to every man, woman, and child living in the State.

In 1863, 1864, and 1865 the insect was again destructive in Illinois and other Western States, its ravages being especially severe in 1864, when we have another attempt at computation of the financial loss. Dr. Henry Shimer, of Mount Carroll, Ill., who had carefully studied the chinch bug, estimated that "three-fourths of the wheat and one-half of the corn crop were destroyed by the pest throughout many extensive districts, comprising almost the entire Northwest." In criticizing the doctor regarding another point, Walsh and Riley[1] admit that the estimate was "a reasonable one," and, taking it as a basis, with the actual cash price per bushel, computed the loss at about 30,000,000 bushels of wheat and 138,000,000 bushels of corn, with a total value of both amounting to over $73,000,000. Of course all computations of this sort are necessarily only approximately correct, but there is more likelihood of an underestimate than of an overestimate in this case.

There was a serious outbreak of the chinch bug in the West in the year 1868, and again in 1871, but in 1874 the ravages were both widespread and enormous. Le Baron computed the loss in 1871 in seven States, viz, Iowa, Missouri, Illinois, Kansas, Nebraska, Wisconsin, and Indiana, at $30,000,000.[2] Riley computed the loss in Missouri alone in the year 1874 at $19,000,000, and added the statement that for the area covered by Le Baron's estimates in 1871 the loss in 1874 might safely be put down as double, or upward of $60,000,000.[3] Dr. Cyrus Thomas, however, estimated the loss to the whole country for the same year at upward of $100,000,000.[4]

The next serious outbreak of the chinch bug of which we have an estimate of the losses occurred in 1887 and covered more or less

[1] Walsh, B. D., and Riley, C. V., editors. Amount of damage done by the chinch bug. *In* Amer. Ent., v. 1, no. 10, p. 197, June, 1869.

[2] Le Baron, William, First Annual Report on the Noxious Insects of the State of Illinois, p. 144. Springfield, Ill., 1871.

[3] Riley, C. V. Seventh Annual Report on the Noxious, Beneficial and other Insects of the State of Missouri, p. 24–26. Jefferson City, Mo., 1875.

[4] Thomas, Cyrus. The chinch bug. U. S. Ent. Com., Bul. 5, p. 7, 1879.

territory in the States of Kentucky, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, and Kansas. In this case the damage was estimated by the United States statistician, Mr. J. R. Dodge, at $60,000,000, the heaviest losses occurring in Illinois, Iowa, Missouri, and Kansas.[1] This gives us as the estimated loss in the 38 years from 1850 to 1887, both inclusive, the enormous sum of $267,000,000.

There was a serious outbreak in Kansas, Iowa, Minnesota, and Illinois, having its beginning probably as early as 1892, but reaching its maximum severity, as in Ohio, in 1896. The loss in Ohio during the years 1894, 1895, 1896, and 1897 could not have fallen far short

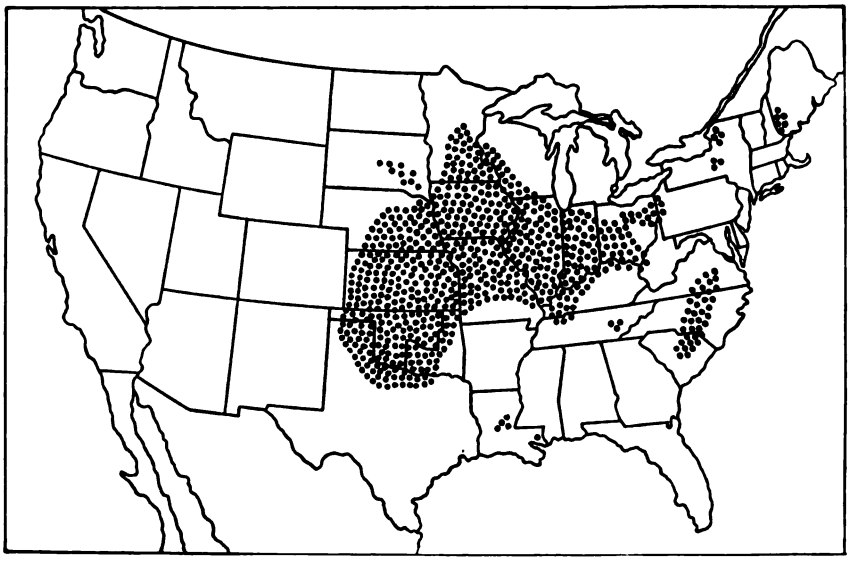

FIG. 6.—Areas in the United States over which the chinch bug occurs in most destructive numbers. (Author's illustration.)

of $2,000,000. If we could have careful estimates of the loss during the last fifteen or twenty years it would in all probability swell the amount to considerably in excess of $350,000,000 for the period from 1850 to 1915. (See map, fig. 6.)

NATURAL ENEMIES OF THE CHINCH BUG.

Chinch bugs have few predaceous insect enemies, none of which, owing perhaps to their repugnant odor, appears to be of any very great importance when it comes to suppressing a serious invasion. They are far more fortunate than most insects in escaping the attacks of natural enemies that exert a tremendous influence in holding other species in check.

[1] Report U. S. Commissioner of Agriculture for 1887, p. 56. Washington, 1888.

THE BOBWHITE OR QUAIL.

Inland the common "quail" or bobwhite is the only bird that can be said to devour the chinch bug in considerable numbers. It is said that from 300 to 400 chinch bugs have been found in the crops of bobwhites; 100, however, is the largest number found so far by the Biological Survey. As the bobwhite is one of our most highly prized game birds, it is slaughtered annually in tremendous numbers, frequently with no object except sport. Some also are killed by flying against electric wires, while during severe winters entire coveys are sometimes smothered or frozen under the snow. As a result the helpfulness of the quail against chinch bugs is greatly diminished. It would seem that as important an enemy of the chinch bug as this bird is known to be would receive protective immunity throughout the agricultural regions and that farmers would see to it that protective laws were not only enacted but also stringently enforced.

The following list will show the degree of protection offered the quail by legislative enactment in the States where the chinch bug is the most destructive (see map, fig. 6). The closed seasons for quail in the several States, during which killing is prohibited by law, are as follows:[1]

Maine, all the year.
New York, protected until Oct. 1, 1918. (Long Island, Jan. 1 to Nov. 1.)
Pennsylvania, December 16 to November 1.
Ohio, protected until November 15, 1915.
Indiana, December 21 to November 10.
Illinois, December 10 to November 11.
Minnesota, December 1 to October 1.
Iowa, December 15 to November 1.
Missouri, January 1 to December 1.
Nebraska, November 16 to November 1 (open season for 15 days only).
Kansas, protected until March 19, 1918.
Oklahoma, February 1 to November 15.
Texas, February 1 to November 1.

The breeding season from latitude 38° northward to Canada begins in May and continues through July and occasionally into September.

OTHER BIRD ENEMIES.

To what extent the birds of the coast region feed upon the chinch bug it is impossible to say. However, among the bird enemies of the pest are the prairie chicken, redwinged blackbird, catbird, brown thrush or thrasher, meadowlark, house wren, tree swallow, horned lark, Arkansas kingbird, Traill's flycatcher, seaside sparrow, savanna sparrow, song sparrow, tree sparrow, and barn swallow.

[1] Palmer, T. S., Bancroft, W. F., and Earnshaw, Frank L., Game Laws for 1914. U. S. Dept. Agr., Farmers' Bul. 628, p. 14-26, Oct. 20, 1914.

THE FROG.

Dr. Cyrus Thomas quotes Ross and others as stating that the common frog is an enemy of the chinch bug. While this is probably true, it is nevertheless well known that comparatively few frogs frequent grain fields, as a rule, and thus the benefit derived from their attacks is of too little importance to merit further notice.

INSECT ENEMIES.

Of the invertebrate enemies of the chinch bug the same may be said as of the frog. The writer has occasionally found a chinch bug containing a species of Mermis, or "hair snake." Occasionally, also, ants may be seen dragging these bugs away, while lady-beetles have sometimes been found to devour them, as recorded by Walsh and Forbes. Perhaps the worst insect enemies of the chinch bug are to be found among its comparatively near relatives—the insidious flower bug,[1] and *Milyas cinctus* Fab., the latter being reported by Thomas as the most efficient of the insect enemies of this pest, while Riley found that the former also attacked it. Prof. Forbes ascertained, by examinations of the contents of the stomach of a ground beetle,[2] that one-fifth of the total food of this species was composed of chinch bugs. Shimer and Walsh both claim that lacewing flies[3] destroy chinch bugs, and they are doubtless correct. The writer has very often found dead chinch bugs entangled in spider webs, although whether killed for food or by accident it has been impossible to determine.

A minute hymenopterous or wasplike parasite of the egg has recently been discovered in Kansas by Mr. J. W. McCulloch of the Kansas Agricultural Experiment Station, but little is as yet known regarding its efficiency as a means of control.

NATURAL CHECKS OTHER THAN ANIMALS.

WEATHER CONDITIONS.

There are two natural checks to the increase of the chinch bug other than animal enemies. One of these is vegetable in nature, being a fungus, the other meteorological, and the interrelation of the two is so close that the former is almost entirely dependent upon the latter. It will at once be seen that the chinch bug, occurring as it does from but little north of the equator to a latitude of nearly 50° north, and from an elevation of more than 200 feet below sea level in the Imperial Valley of southern California to upwards of 6,000 feet above sea level in the mountainous regions, must be able to withstand almost every conceivable variation of climatic conditions.

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[1] *Triphleps insidiosus* Say (*Anthocoris pseudo-chinche* of Fitch's Second Report).
[2] *Agonoderus pallipes* Fab.
[3] *Chrysopa* spp.

(See map, fig. 7.) So far as the influence of temperature is concerned, it is only in the most unprotected situations that severe winter weather appears to have much effect in regulating the abundance of the pest, although frequent freezing and thawing is known to be

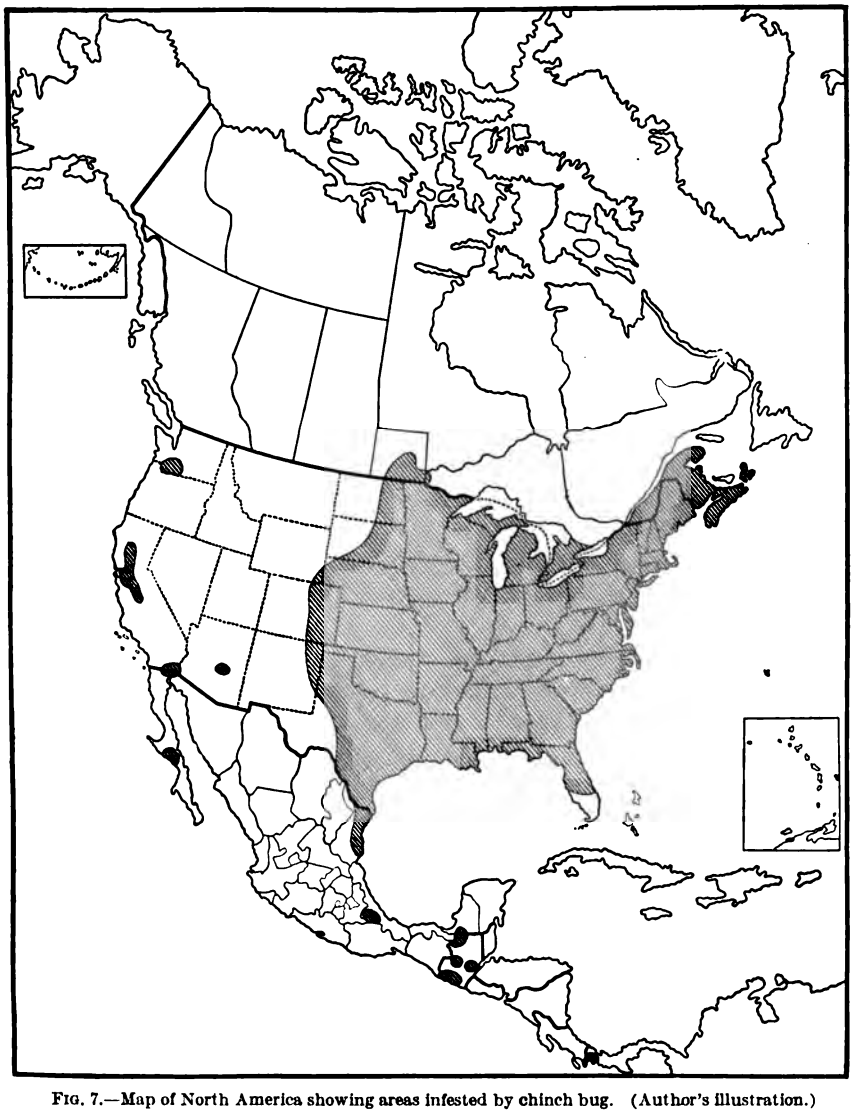

FIG. 7.—Map of North America showing areas infested by chinch bug. (Author's illustration.)

fatal to a large percentage of the adults if these occur in exposed situations. Thus temperature may practically be eliminated from consideration. It is also true that the nearly developed insect will withstand not only the humidity of the Tropics, but continuous drenching rains of more northern latitudes. It is at the time of

hatching that the species is most susceptible to meteorological conditions. Frequent drenching rains during the hatching season are fatal to the pest almost to the extent of extermination, and it is due to this more than to any other influence that the chinch bug is kept within the limits of its present abundance and destructiveness. It matters little how great a number of these insects pass the winter in safety, provided there are sufficiently prolonged, drenching rains during the hatching period. Again, with an excessive abundance of individuals developing from the first generation, if at the time of the hatching of the young of the second generation there are frequent drenching rains, an outbreak the following year is prevented. Thus it is that although an outbreak may seem inevitable as the season for the ravages of the chinch bug draws near, there is often a radical reduction instead of an increase in numbers. The forecasting of chinch-bug outbreaks is therefore based wholly upon the uncertain forecasting, months in advance, of meteorological conditions that are likely to occur at certain periods. If the farmer would but watch the seasons he need not be taken unawares by chinch-bug outbreaks, as dry weather during the two breeding seasons is usually sufficient to precipitate an invasion the following year, providing that, at the critical period, or time of hatching, rains do not destroy the young. The general statement may be made that throughout the Middle West a dry June followed by a dry August is favorable for the development of chinch bugs. These dates will of course vary, and must not be applied to the more southern or more northern localities.

PARASITIC FUNGI.

The fact that the abundance and consequent influence of fungous enemies of the chinch bug are almost entirely dependent upon meteorological conditions is sufficient to place them in a secondary position, even though they may, under favorable weather conditions, act as natural checks.

Dr. Henry Shimer[1] long ago made the truthful and important statement that "this disease among the chinch bugs was associated with the long-continued wet, cloudy, cool weather that prevailed during the greater portion of the period of their development." These are precisely the conditions under which these fungi have been observed to prove the most fatal to the chinch bug during recent years where their introduction among the host insects was accomplished by artificial means. Although Shimer probably never anticipated the artificial cultivation of his "disease" and the results which have since been obtained from its artificial dissemination in the fields, yet his careful and painstaking studies must ever be

[1] Shimer, Henry. Notes on *Micropus* (*Lygæus*) *Leucopterus*, Say ("The Chinch Bug"). With an account of the great epidemic disease of 1865 among insects. *In* Proc. Acad. Nat. Sci. Phila., v. 19, p. 75-80, May, 1867.

associated with the application of fungous diseases in the destruction of insects in America.

The principal fungus to be artificially employed in destroying chinch bugs has come to be known as the chinch-bug fungus [1] and this is the one used by the late Dr. Snow in Kansas for artificial introduction into localities where there was an overabundance of these bugs.

Drs. Roland Thaxter and S. A. Forbes devised a method of artificial cultivation, the latter using a basis of sterilized mixture of beef broth and corn meal. As this fungus has many other host insects, it is probably present to a greater or less degree throughout the country every year. There is no doubt that during wet weather considerable benefit may be derived from the artificial cultivation and application of this fungus, but its efficiency is very dependent upon this meteorological condition, and, as has already been shown, chinch bugs develop in the greatest abundance in dry seasons. It will thus be seen that only during unusual seasons—that is to say, seasons that have been dry while the chinch bugs were hatching from the eggs but wet afterwards—can satisfactory results be expected from this measure.

The effects of this fungus have probably been overestimated, although there is no doubt whatever that those who have been most instrumental in popularizing this means of destroying chinch bugs were thoroughly sincere and honest in their statements. One very important element of deception to the ordinary farmer, when assuming the results of the effect of this fungus, lies in the fact that chinch bugs, when molting for the last time and passing from the last-stage larva to the adult, hide away under the sheaths of corn and other grain, and, casting the larval skin, make their escape, leaving this behind. These cast skins will occur in immense numbers in such places and frequently become covered with a white mold. It is almost impossible for anyone except an expert to distinguish the difference between chinch bugs that have been actually killed by this fnugus and the mass of cast skins covered with ordinary mold. The uncertainty as to the effects of this fungus is responsible for the fact that it has fallen largely into disuse during recent years. It will thus be seen that this whole matter hinges upon meteorological conditions which are, as has been stated, most powerful factors in holding the chinch bug continually in check, and it is following a succession of dry seasons that the pest commences to become destructive. During seasons of excessive abundance of chinch bugs this fungus will almost invariably appear among them in the fields, provided that at this time there occurs a considerable period of wet weather. Up to the present time absolute proof has not been

[1] *Sporotrichum globuliferum* Speg.

obtained that this fungus attacks and kills otherwise healthy individuals or that fatalities are not confined to spent females or those of both sexes that have become physically weakened by other causes.

REMEDIAL AND PREVENTIVE MEASURES.

All remedial and preventive measures that have been found to possess the merit of reasonable efficiency and practicability are discussed in the following pages. These may not all prove applicable in all localities or under every variety of circumstance, and the farmer will often have to adapt his protective measures to weather conditions, location of field and its surroundings, and to the thousand and one other variations of a similar nature.

DESTRUCTION OF CHINCH BUGS WHILE IN HIBERNATION.

The first effort that may be made with a view to warding off an attack of chinch bugs is to destroy them in their winter quarters. This can be accomplished by burning all dried grass, especially such as grows in clumps, notably broom sedge or sage grass, leaves, or other rubbish during winter or early spring, especially during early winter. The burning of such will destroy thousands of bugs in their winter quarters; but sometimes the matted bluegrass remains green in winter, or the weather is not sufficiently dry to enable the farmer to burn over such places. In such cases a flock of sheep, if given the freedom of the fields during winter and spring, will eat off all living vegetation and trample the ground with their small feet, so that not only is all protective covering for the bugs removed, but also the bugs are crushed. So it is with the matted grass along roadsides and fences, especially the Virginia worm rail fence (fig. 8). The greater ease with which the narrow strip of grassland along a post-and-wire fence can be kept free of matted grass and leaves, as compared with that along a hedge or rail fence, indicates that there may be an entomological factor connected with the modern farm fence that has been overlooked, giving it, in this respect, an advantage over the more ancient form.

A good illustration of the fact that large numbers of chinch bugs may be in hiding among fallen leaves in woods and other places and escape detection is furnished by a collection, made late in April, of a quantity of dried leaves from about a vineyard located on a narrow neck of land about one-fourth of a mile from the Bay of Sandusky on the one side, and about one and one-half miles from the shore of Lake Erie on the opposite side. At the time of collecting the leaves only an occasional chinch bug was to be observed, but under a warm atmosphere they began to bestir themselves and soon demonstrated that there had been a large number ensconced unseen among the dried and curled dead grape leaves.

Shocks of fodder corn left in the fields over winter certainly afford protection for many chinch bugs, as will also coarse stable manure spread on the fields before the chinch bugs have selected their place of hibernation in the fall. In short, the first protective measure to be carried out is a general cleaning up in winter or early spring, either by burning, or pasturing, or both.

SOWING DECOY PLATS OF ATTRACTIVE GRAINS OR GRASSES IN EARLY SPRING.

Judging from the manner in which the overwintered adults are attracted to hills of young corn, wheat fields, or plats of panic and foxtail grasses, it has always seemed to the writer practicable to take

FIG. 8.—Poorly kept roadside with rail fence overgrown with brambles, thus affording protection for large numbers of destructive insects during winter. (Author's illustration.)

advantage of this habit and sow small patches of millet, Hungarian grass, spring wheat, or even corn, early in the spring and thus bait the adults as they come forth from their places of hibernation. Their instincts will prompt them to seek out the places likely to afford the most desirable food supply for their progeny, and if an artificial supply can be offered them that will be more attractive than that furnished by nature, the bugs will certainly not overlook the fact, but will take advantage of it to congregate and deposit their eggs there, whereupon eggs, young, and adults can be summarily dealt with a little later by plowing both bugs and their food under and harrowing and rolling the ground to keep the former from crawling to the surface and escaping.

The writer has thoroughly tested this method in a case where the bugs, young and old, had taken possession of a plat of neglected ground overrun with panic grass which was mown and promptly removed and the ground plowed, harrowed, and rolled before the bugs could escape, thus burying them beneath several inches of soil, out of which they were unable to make their way. As a consequence they were almost totally annihilated, hardly 1 per cent making their escape to an adjoining cornfield.

WATCHFULNESS DURING PROTRACTED PERIODS OF DROUGHT.

It has always appeared to the writer as though a little watchfulness on the part of farmers during periods of drought might enable them to determine whether or not chinch bugs were present in any considerable numbers in their fields in time to interpose a strip of millet between the wheat and corn, to be utilized later as previously indicated. Instances have come under observation where, in wheat fields overgrown with panic grass and meadow foxtail, the bugs transferred their attention to these grasses as soon as the wheat was harvested. In such cases a prompt plowing of the ground would have placed the depredators beyond the possibility of doing any serious injury. If the weather at the time is hot and dry, a mower may be run over the stubble fields or along the borders, cutting off grass, weeds, and stubble, as the case may be, leaving them to dry in the hot sun, when, in a few hours, they will burn sufficiently to roast all bugs among them, and, while not destroying every individual, this will reduce their numbers to such an extent that they will be unable to work any serious injury.

DIFFICULTY OF REACHING CHINCH BUGS IN MEADOWS.

There is, however, some doubt in regard to the practicability of applying these measures in timothy meadows. Meadow lands can be burned over with perfect safety to either the grass or clover, if done while the ground is frozen, but there is danger of injury if burned over in spring, and it is somewhat doubtful if the hibernating chinch bugs would be killed unless the surface of the ground was heated to a degree that the grass and clover plants would hardly be able to withstand.

Infested areas of meadow land could be plowed, it is true, but the work would have to be done very carefully, else the grass and stubble would be left to protrude above ground along each furrow and constitute so many ladders by which the chinch bugs could easily crawl out and make their escape. Where the ground will admit of subsoiling, or where a "jointer" plow can be used, this latter difficulty can be easily overcome. Usually, however, the chinch bugs work too irregularly in a field to permit of plowing under infested areas

without disfiguring the field too much for practical purposes, especially in the case of meadows, unless it be where the bugs have migrated en masse from an adjoining field, when a narrow strip along the border can often be sacrificed to good advantage. In many instances the drastic measure of turning under a few outer rows of corn with the plow would have saved as many acres from destruction. In the majority of cases it is the fault of the farmer himself that these measures are not effective, as he will seldom take the trouble to burn the dead leaves, grass, and trash about his premises at the proper time, and when there occurs an invasion of chinch bugs, instead of resorting to heroic and energetic measures to conquer them on a small area, he usually hesitates and delays in order to determine whether or not the attack is to be a serious one, and by the time he has decided which it is to be the matter has gone too far and the chinch bugs have taken possession of his field. This is especially true in the West, where the bugs breed exclusively in the fields of wheat, rye, and barley, often remaining unobserved until harvest, when they suddenly and without warning precipitate themselves upon the growing corn in adjacent fields. In fighting the chinch bug, promptness of action is about as necessary as it is in fighting fire.

ELIMINATING CHINCH BUGS FROM TIMOTHY MEADOWS BY CROP ROTATION.

In several instances where chinch bugs have become especially destructive to timothy meadows over considerable areas of country, it has been found that these outbreaks were attributable to the fact that these sections of country were largely given over to dairying. The dairymen and stockmen found it more desirable to allow timothy pastures and meadows to remain more or less permanent, with the result that the chinch bugs gradually became so excessively abundant as to destroy the grasses on these areas. In a number of instances it was found that where the prevailing agricultural methods were changed and the infested grasslands were broken up and devoted to other crops, the difficulty was eliminated, as the new meadows were not attacked. This shows that throughout the country where the short-winged chinch bug attacks timothy meadows a rotation of crops will be found an efficient measure in overcoming the difficulty with a reasonable degree of permanency.

UTILITY OF KEROSENE IN FIGHTING CHINCH BUGS.

In fighting the chinch bugs there is at present no more useful substance than kerosene, either in the form of an emulsion or undiluted. From its penetrating nature, prompt action, and fatal effects on the chinch bug, even when applied as an emulsion, it becomes an inexpensive insecticide, while it has the further advantage of being an article universally found in every farmhouse, and is therefore always

at hand for immediate use. The emulsion has the further advantage that it can be reduced sufficiently in strength to preclude injury to the vegetation and still be strong enough to be fatal to insect life.

Diluted and ready for use, the emulsion is prepared as follows: Dissolve one-half pound of hard soap in 1 gallon of water, preferably rain water, heated to the boiling point over a brisk fire, and pour this suds while still hot into 2 gallons of kerosene. Churn or otherwise agitate this mixture for a few minutes until it becomes of a creamlike consistency and, on cooling, forms a jellylike mass which adheres to the surface of glass without oiliness. For each gallon of this emulsion use 15 gallons of water, mixing thoroughly. If applied to growing corn, it will be best to use the emulsion either during the morning or evening, say before 8 a. m. or after 5 p. m., as at these times it will be less likely to affect the plants than if applied in the heat of the day. The great drawback in its use is that if not properly made it will prove as destructive to the corn as the bugs.

Where an invasion of the chinch bug is in progress from a field of wheat to an adjoining field of corn, as an illustration, the marginal rows of corn can be frequently saved, even after the bugs have massed upon the plants, by spraying or sprinkling them freely with kerosene emulsion, being careful not to get much of it directly into the crown of the plants, and using a sufficient quantity so that the emulsion will run down the outside and reach such bugs as are about the base of the plants. This treatment will kill the bugs clustered upon the corn, and while it will not keep out those on the way to the field, it will cause a halt in the invasion, and thus give the farmer an opportunity to put other measures in operation, one of which will include the use of kerosene in another manner. In cases where the young bugs have already taken possession of one or two border rows of corn and quick action is required on the part of the farmer in stopping their advance, the drenching of the corn plants by a strong soap suds, 1 pound of soap dissolved in 4 gallons of water, may be of service. If a deep furrow is plowed along the edge of the field (fig. 9), running the land side of the plow toward the field to be protected, the furrow will form a temporary barrier to the incoming hordes.

UTILITY OF DEEPLY PLOWED FURROWS SUPPLEMENTED BY THE USE OF KEROSENE EMULSION.

In dry weather the sides of the furrow can be made so steep and the soil so finely pulverized that when the chinch bugs attempt to crawl up out of the furrow they will continually roll back to the bottom. In case of showery weather, which prevents the sides of the furrow from remaining loose and dry, the bottom can be cleared out with a shovel, making it more smooth and the side more perpendicular, thus rendering it so much easier for the bugs to follow along the bottom than to

attempt to climb the sides. If holes are dug across the bottom at distances of, say, 30 or 40 feet, the bugs will fall into them and can be still more easily disposed of by the use of kerosene. That both of these measures are thoroughly practicable the writer can attest by ample personal experience, and he knows that under most conditions that are likely to obtain prompt and efficient application is all that is necessary. During showery weather the tar line is far preferable to the furrow, but in excessively dry, windy weather the dust will adhere to the tar and encrust the surface so that the bugs can soon easily

FIG. 9.—The two operations in the preparation of chinch-bug barriers; one, the plowing of the furrow; and the other, the dragging of a log or other heavy cylindrical object of the proper size back and forth in the furrow to keep the soil pulverized and prevent the bugs from making their way out of the sand. (Original.)

walk across. This is a case where a farmer must use his own judgment. During a few days this work will demand the closest watching and application, but fields of corn can be protected thoroughly and effectually if these measures are faithfully carried out, and the expense of time and money will be found to be less than in almost any other plan that has been discovered up to this time. In no case has a field attacked by a migrating army of chinch bugs come under the writer's observation that could not have been saved from very serious injury by the prompt use of either of these measures, although

under some conditions the farmer might find it advantageous to apply some of the other methods of protection here given. In all of the following methods crude petroleum or road oil may be substituted for coal tar if the former is more easily obtainable.

THE SURFACE AND COAL-TAR OR ROAD-OIL METHOD.

The objections made by farmers to the use of most of these barriers is that the most finely pulverized soil soon becomes incrusted by even the slightest rainfall and the bugs then pass over it without difficulty, while barriers of boards are expensive. It is feasible to eliminate both by simply smoothing off a path along the margin of an infested field where such an one adjoins the one to be protected. This can be done with a sharp hoe, and as the margins of wheat fields usually become compacted, it is but little trouble thus to clear off a path a foot or more in width, smooth as a floor, with the surface almost as hard. Along this path circular post holes are sunk, as in the bottom of furrows, and a train of coal tar is run between them, being so arranged that it will reach the post hole at the edge farthest from the field from which the bugs are migrating. The bugs, on reaching the train of tar or oil, will follow along until they reach the post hole, while those meeting with the post hole will usually divide and, following around it, join with the flow of bugs moving along the barrier. The result is that they become congested in the acute angle where this barrier is intercepted by the post holes. Those in the apex of this angle can not turn back, and thus are continually pushed into the post holes by those behind. As the bugs, varying from the red larvæ of the younger stages to the almost black ones of the last stage, mass along the line of coal tar, they have much the appearance of a reddish-brown stream running into the holes. From these holes there is no escape and here the bugs can readily be killed by sprinkling with kerosene. The slightest train of coal tar is sufficient to obstruct the passage of the bugs, and light rains will not affect its efficiency.

In dry weather these trains of tar or oil, as the case may be, soon become covered over with dust and must be renewed; but in showery weather there is no dust, and if the coal tar is renewed daily or, at most, twice each day, it will accomplish its work and nothing further will be needed than to kill the bugs that have collected in the post holes. This measure is inexpensive and can be promptly put into operation if the coal tar is at hand. The writer has been able in this way effectively to protect a field of corn bordered on two sides by a wheat field literally overrun with chinch bugs at harvest and during a time when light showers were occurring, frequently several times each day.

THE RIDGE AND COAL-TAR METHOD.

Differing quite materially from the preceding are the various combinations of coal tar or road oil and ridges of earth, smoothed and packed along the apex, or, instead of the ridge of earth, 6-inch boards, such as are ordinarily used for fencing, placed on edge and the upper edge coated with tar.

Prof. Forbes has reported excellent results from the application of a line of coal tar put directly upon the bare ground where the surface has been rendered compact by a recent fall of rain. Even in this series of protective measures kerosene can be used to great advantage. In the experiment recorded by Forbes the coal tar was put upon the ground between a wheat field and a cornfield from an ordinary garden sprinkling pot from which the sprinkler had been removed and the orifice of the spout reduced in size with a plug of wood until the tar came out in a stream about the size of the little finger and made a line on the surface of the ground about three-fourths of an inch in width. Post holes were sunk along the line from 10 to 20 feet apart on the side next to the wheat field, thus practically completing the barrier, and the chinch bugs, being unable to cross the line of tar, accumulated in the post holes in vast numbers, where they were killed, and those bugs that had already entered the cornfield before the barrier was constructed were prevented from spreading farther by tar lines between the rows of corn, the infested corn itself being cleared of bugs by the application of kerosene emulsion. The same writer [1] states that several farmers in Vermilion County, Ill., prepared for the coal-tar line by hitching a team to a heavy plank and running this, weighted down with three or four men, over the ground once or twice until a smooth, hard surface had thus been made to receive the tar. If the barrier was to be made in sod, a furrow was plowed and the bottom of this made smooth by dragging the plank along the bottom. In both cases post holes were sunk along the tar lines, and in these were placed cans or jars into which the bugs fell in myriads and were destroyed.

On one farm of 250 acres a coal-tar line 90 rods in length was renewed once each day and killed about 8 gallons of chinch bugs. In the case of another farmer there were 300 rods of tar lines with post-holes, cans, etc., which resulted in destroying about 10 bushels of chinch bugs. A 6-gallon jarful was destroyed in less than half a day at one point on the line. In this last instance the lines of tar were renewed three times a day, but even then less than a barrel of tar was used. Still another farmer, with 120 rods of tar line, used about a third of a barrel of tar and did not lose a hill of corn; he caught

[1] Forbes, S. A. Twentieth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois. Ninth Report of S. A. Forbes for the years 1895 and 1896, p. 39–40, Springfield, Ill., 1896.

chinch bugs by the bushel. In some of the cases cited the tar line was run in a zigzag course, the postholes being situated at the angles, and in others leader tar lines were run obliquely to the main tar line, one end terminating at the traphole, but both of these plans were afterwards regarded as unnecessary, a single straight line being entirely sufficient and less expensive. The numerous cases where these methods were put into execution with entire success and at small expense afford the best possible proof of their practical utility. If a farmer is situated near town, where refuse tin cans are dumped in any locality where they can be got out of the way, he can select the larger of these, set them in the postholes, and partly fill them with kerosene and water. The water, being heavier than the kerosene, will sink to the bottom, leaving a stratum of kerosene on the surface. The chinch bugs falling into this will be forced down by the weight of those coming after, and thus all will be passed through the kerosene into the water below. This will obviate the necessity of frequently emptying the cans or treating their contents. It may also be stated that where the postholes are quite deep and enlarge at the bottom the bugs falling into them will perish without further attention.

OTHER BARRIER METHODS.

The late Dr. Snow, working in Kansas, followed a somewhat different method, and one that, under certain conditions, might be found superior to that used by Prof. Forbes, or the furrow and kerosene method applied by the writer in Ohio. This modification consists in throwing up a double furrow, known among farmers as "back furrowing," thus forming a ridge the top of which is smoothed and packed with a drag having a concave bottom of the form of the ridge to be made. If the bottom of this drag is covered with zinc it will be found to keep bright and polished, and by this means make a smoother ridge. Along the top of this ridge is run a train of coal tar as it came from the gas works, or crude petroleum as taken from the oil wells. The former is more easily obtained, except in certain localities, and will probably be found the more practical, as it stands on the surface better and is not so readily washed away by rains. Both of these substances are, however, offensive to the bugs, and they will seldom attempt to cross them or even come close enough to touch them, but on approach will turn and run along the ridge in the evident hope of finding a gap through which they can pass. Postholes were dug on the outside of the line, but close up to it, so that the bugs in passing along beside the tar line would crowd each other into them. Dr. Snow suggested that it is best to construct this barrier several weeks prior to the time when it will be needed, as then the tar line has but to be run along the ridge and the postholes dug, when

the whole system is complete, and the chinch bugs can be thus shut out from the first.[1]

With these barriers of either ridge or furrow and the use of coal tar or crude petroleum, supplemented by kerosene emulsion, a very large percentage of the injury from chinch bugs may be obviated, and, in fact, with a reasonable degree of watchfulness and prompt action all injury from migrating hordes may be prevented. The use of tarred boards set on edge or slightly reclining might, under some circumstances, take the place of the ridge or furrow, but these cases will be exceptional, and the use of kerosene emulsion will probably be found equally practicable here, as also will the post holes for collecting the chinch bugs. This method is merely cited in order to call attention to its possible use where the others are found impracticable.

THE USE OF FURROWS WITHOUT PETROLEUM OR COAL TAR.

The plowing of furrows (fig. 9) has been in vogue since the first writings of Le Baron and the second report of Fitch, and may be utilized in other ways than those previously mentioned. A heavy log or other cylindrical object of the proper size dragged back and forth in this furrow will pulverize the soil in dry weather, and Dr. Forbes has recorded the fact that where this furrow has a temperature of 110° to 116° F. it is fatal to the young bugs that fall into the furrow, even if they are not killed by the log. As 120° is not uncommon in an exposed furrow on a hot summer day, it will be observed that there may be cases where this method will be found very serviceable, and especially is this likely to prove true in a sandy soil with a southern exposure. In sections of the country where irrigation is practiced, these furrows may be flooded and in this way rendered still more effective without the expenditure of either time or money to keep them in constant repair. Riley long ago laid considerable stress on this measure, believing it of much value, especially in the arid regions of the far West. The same writer advised the flooding of infested fields, wherever it could be done, for a day or so occasionally during the month of May. It is hardly probable, however, that this will often be found feasible except in rice fields, where it is sometimes practiced.

NECESSITY FOR PREVENTING CHINCH BUGS FROM BECOMING ESTABLISHED IN FIELDS OF WHEAT AND GRASS.

In the foregoing it will be observed that prevention of migration has been the chief end in view, either by destroying the chinch bugs in their hibernating quarters, and thus preventing the spring migration to the breeding places, or by various traps and obstructions to prevent them from migrating from such places to others not already

[1] Snow, F. H. Contagious diseases of the chinch bug. Univ. Kans. Exp. Sta. Fifth Ann. Rpt. of the Director for the year 1895, p. 45–47, 1896.

infested. The great problem remaining to be solved is to prevent their breeding in wheat fields at all. As has been shown, it is absolutely impossible with our present inability to forecast the weather months in advance, to be able to foretell whether or not an outbreak of chinch bugs is likely to take place. There may be an abundance of bugs in the fall—enough to cause an outbreak over a wide section of country—and these may overwinter in sufficient numbers to cause some injury in spring, yet a few timely, drenching rains will outbalance all of these factors, and our wisest prognostications fail of proving true. It is this very factor of uncertainty that renders unlikely the successful carrying out, over any large area of country, of any protective measures, where, as in this case, the benefit to be derived will only be realized nearly a year afterwards, if at all. The average farmer, when smarting under a heavy loss, will often take such long-range precautions as to sow belts of flax, hemp, clover, or buckwheat around his wheat fields once; but if the chinch bugs do not appear, and he sees the useless investment of time, labor, and seed, he will be likely to conclude next year to take the risk and do nothing. For the present, then, we have no method whereby we can prevent the chinch bugs from taking up their abode in wheat fields or timothy meadows and raising their enormous families there, except to destroy the adults in their winter quarters.

The writer once tried to destroy the young in a wheat field by spraying with kerosene emulsion the small areas of whitening grain that indicated where the pests were massed in greatest abundance. The result was unsatisfactory, and it is very doubtful if it is possible to apply this measure with any degree of success, and we are forced to the conclusion that, for the present at least, we shall be obliged to rely upon the measures previously given. It therefore becomes of the utmost importance to clean up the roadsides and the ground along fences and patches of woodland, as well as any other places likely to afford protection for the hibernating chinch bugs. There are, of course, obstacles in the way of carrying out this plan generally over any large area of country, and especially in sections where the rail fence predominates. But as the country gets older it will be found that it is not chinch bugs alone that seek these places in which to pass the winter, but myriads of the other insect foes of the farmer as well, and that careful attention to the condition of roadsides, lanes, hedgerows, and waste places about the farms, during the season when insects seek out these places wherein to pass the winter, will pay well for the time expended in that direction. It may come about that some phase of the street-cleaning reform may invade the country, and it is certain that if such were to occur it would, in time, save the country enough to go far toward reducing the expense of securing good roads. In fact, the term "good roads" ought to include

the proper care of the roadsides as well as the grading and macadamizing of the roadbeds.

There are at present so-called "weed laws" in many States, and, though more or less of a dead letter in some cases, these laws are steps in the proper direction. The time when insect pests will be looked upon, in the eye of the law, as so many public nuisances, and the harboring of them a corresponding crime, may be a long way off, but as it gradually draws nearer we shall come to learn that after all it is the rational view to take and will go far toward solving not only the chinch-bug problem, but many others of a similar nature. So far as the chinch bug is concerned, when we burn over the waste lands and accumulated rubbish about our farms in autumn or winter we are simply applying the same check that the dusky savage did when he lighted the prairie fires, though unwittingly and for an entirely different purpose. In the timothy meadows of the northeastern portion of the country where, for lack of wings fitting it for locomotion, the chinch bug does not so largely migrate to the waste lands in autumn, the problem is somewhat different, and it will require some careful experiments to determine the exact effects both on the hibernating chinch bugs and on the grass roots of burning over the meadow lands in winter. There can be little doubt, however, that a rapid rotation of crops, so as not to allow the short-winged form to become thoroughly established in a meadow, and the burning over of waste places, thus destroying such rubbish and débris as will serve to offer hibernating places for the long-winged form, will go far toward settling the chinch-bug problem in grasslands.

As previously stated, the chief drawback in putting preventive measures in force is the difficulty of foretelling an invasion. In northeastern Ohio in 1897 hundreds of acres of timothy meadow were destroyed after the hay crop had been removed, but so late that the farmers did not suspect the true condition of their meadows until the spring of 1898, when the young grass failed to put forth, and an examination revealed the fact that the roots had been killed, the abundance of chinch bugs pointing unerringly to the cause of the trouble, though in many cases a heavy crop of hay had been removed the previous year where now the ground was entirely bare. While in the case just cited a previous knowledge of the presence of chinch bugs in these meadows might not have enabled the owners to have saved them in the fall of 1897, yet fall plowing of the land, possibly early enough to have had the ground sown to fall wheat, would have buried the majority of the bugs so deeply in the soil as to have killed vast numbers of them and thus prevented their migration to other lands in the spring of 1898. A rotation of crops that would have included grass for not to exceed two successive

years, followed by wheat, would have amounted to precisely the same remedial measure as the one suggested.

A case in northeastern Ohio has come to the writer's notice where an infested timothy meadow was plowed late in the fall of 1897. Late in April of 1898 this ground was cultivated, rolled, and harrowed several times and most carefully and completely prepared for corn, which was planted, but with the result that a portion of the field was attacked and destroyed by chinch bugs, largely of the short-winged form. An examination about June 10 revealed the bugs in considerable numbers about the plants still remaining, but scattered over the field were more or less numerous clumps of timothy, in some cases apparently killed by the chinch bugs, while in others the bugs were literally swarming about the dying but still green clumps of grass, thus showing that they had either not been buried by the plowing and cultivation of the ground or else the grass had not been thoroughly covered, and thus ladders had been left whereby the bugs were enabled to climb to the surface.

SUMMARY OF REMEDIAL AND PREVENTIVE MEASURES.

In summing up the matter of remedial and preventive measures for the control of the chinch bug, it may be stated that the insects can be destroyed in their places of hibernation by the use of fire. They can be destroyed while in the act of migrating from one field to another by barriers or deep furrows supplemented by post holes and by burying them under the surface of the ground with the plow and harrow, or the latter method may be applied after the bugs have been massed upon plats of some kind of vegetation for which the bugs are known to have a special fondness, these decoy plats being so arranged as either to attract the females and induce them to oviposit therein or to intercept an invasion from wheat fields into cornfields. When these decoys have been turned under with a plow and the surface immediately smoothed and packed by harrow and roller the bugs will be destroyed, while in the cornfields they can be destroyed on the plants by the application of kerosene emulsion. Without vigilance and prompt action, however, only indifferent results are to be expected from any of these measures.

There are several spraying materials which can be used effectively against the bugs after they have congregated on the young corn, but, unfortunately, most of these are injurious to the plants. Kerosene emulsion of 5 per cent strength will generally kill the bugs and will not always injure the corn. The stock solution is made by boiling 1 pound of good lye soap in 1 gallon of water, adding this to 2 gallons of kerosene, and stirring the mixture with a paddle for 5 to 10 minutes. A better way to stir the mixture is to put the nozzle of the spray in the vessel and pump the liquid back into the vessel for five minutes.

Dilute the mixture to a 4 or 5 per cent solution by adding soft water. Some of the proprietary spraying materials and cattle dips

have been used to kill the bugs where they have become alarmingly abundant. One serious objection to these materials is that they are very often injurious to the plants. However, it is sometimes better to sacrifice the first few rows and save the cornfield than to let the bugs have their way.

DESTRUCTION OF CHINCH BUGS WHILE IN HIBERNATION.

The burning of grasses and rubbish about the farm during winter to destroy hibernating chinch bugs has been often recommended and is doubtless the most effective measure to be taken against future ravages of the pest.

In the Southwest the chinch bugs are known to congregate in bunches of grass in late October and remain there till the warm days of early spring. It is only a matter of burning off these grasses at the proper time effectually to rid such places of the pest, and the grasses are generally sufficiently dry to burn readily by the first of of November. The chinch bugs crawl deep down among the grass stems, a few of them even getting beneath the dust and débris, thus seeking protection from the freezes that are to come. It is very important that the grass be dry and yet burn slowly, so that the heat will thoroughly penetrate the dense grass and reach the bugs. It is not necessary for the fire to come into direct contact with the bugs in order to kill them, as they died very quickly in the laboratory when exposed to the heat of a flame from 12 to 20 inches distant, the fatal temperature being in these experiments about 111° F. Fall burning of the grasses among which the bugs are congregated has a twofold value—first, it will kill large numbers of bugs directly; and, second, the bugs not killed by the fire will be left exposed to the winter freezes, which of themselves will in ordinary seasons kill many of them. On several occasions during fall and spring bugs were removed from the stubs of burned grass and the percentage of dead and live bugs obtained. On an average about 75 per cent were killed in the fall and about 63 per cent in the spring. In the spring about 20 per cent of the bugs which hibernated in the clumps of grasses were dead from exposure and other causes. From natural causes and burning in spring about 83 per cent of the bugs were dead. These percentages were obtained by actual count of the insects and are not from estimates. The fire can not reach all the bugs, even with the most careful burning, because of protection afforded by green or wet stems in early fall and late spring; therefore it is essential that the grass be burned during late fall or early winter. While this remedy is recommended above all others, its effectiveness is entirely dependent upon the farmers and their cooperation, but it is an easy matter for neighborhoods to combine in an effort to fight the pest in this manner.

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Contribution from the Bureau of Entomology, L. O. Howard, Chief.

COCKROACHES.

By C. L. MARLATT,
Entomologist and Acting Chief in the Absence of the Chief.

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INTRODUCTION.

Roaches are among the commonest and most offensive of the insects which frequent human habitations. They were well known to the ancients, who called them *lucifuga*, from their habit of always shunning the light. The common English name for them, or, more properly, for the common domestic English species, is "black beetle." In America this name has not been adopted to any extent for this insect, which was early introduced here, and the term "roach," or "cockroach," is the common appellation of all the domestic species. The little German roach, however, is very generally known as the "Croton bug," or "water bug," from its early association with the Croton waterworks system in New York City. The popular designations of this insect in Germany illustrate in an amusing way both sectional and racial prejudices. In north Germany these roaches are known as "Schwaben," a term which applies to the inhabitants of south Germany, and the latter section retaliates by calling them "Preussen," after the north Germans. In east Germany they are called "Russen," and in west Germany "Franzosen," the last two appellations

NOTE.—This bulletin is of special interest to housekeepers throughout the United States. It is a revision of Circular No. 51 of the Bureau of Entomology, U. S. Department of Agriculture.

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indicating a certain national antipathy to rival countries as well as a fanciful idea as to origin. Still other names are "Spanier," dating from the time of Charles V, and "Däne," from Denmark.

DISTRIBUTION AND HISTORY.

The roaches belong to a very extensive family, the Blattidæ, comparatively few of which, fortunately, have become domesticated. In temperate countries some four or five species are very common household pests, and a few occur wild in the woods; but they are essentially inhabitants of warm countries, and in the Tropics the house species are very numerous, and the wild species occur in great number and

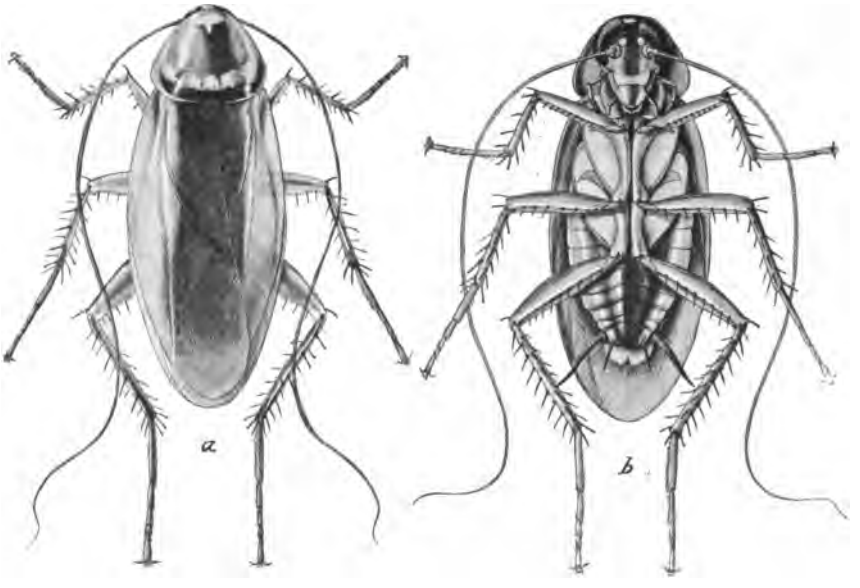

FIG. 1.—The American roach (*Periplaneta americana*): *a*, View from above; *b*, from beneath. Both enlarged one-third. (Author's illustration.)

variety, many of them being striking in shape, coloration, and size, one species expanding more than 6 inches. The inability of the domestic roaches to withstand unusual cold was illustrated by the fact that the severe weather in the winter of 1894 in Florida, which was so destructive to the citrus groves, on the authority of Mr. H. G. Hubbard destroyed all the roaches, even those in houses, except a few unusually well protected. Under suitable conditions in the more northern latitudes the domestic species often multiply prodigiously, and even in the far north a species occurs in the huts of the Laplanders, and sometimes entirely devours the stores of dried fish put away for winter consumption.

While the domestic species are few in number, nearly a thousand species of Blattidæ have been described and preserved in collections, and it is estimated that perhaps upward of 5,000 species occur at the present time in different parts of the world. The great majority of the roaches live outdoors, and in warm countries have the reputation of living on plants and sometimes being very injurious. This belief has been recently questioned by Mr. J. G. O. Tepper, of South Australia, who states that in his experience these insects are eminently carnivorous, feeding on caterpillars and other soft-bodied insects, and that with the increase of certain species in his gardens, notably *Epilampra notabilis*, "the herbivorous larvæ disappear rapidly." Mr. Tepper points out that the injury to plants occasionally noted where roaches are abundant may very possibly be due to other insects or to snails which again have attracted the roaches and on which the latter feed. That roaches will eat fruits and the starchy tubers and other products of plants is a common observation, but that they ever subsist on the green foliage of plants may be open to doubt.

The roach is one of the most primitive and ancient insects, in the sense of its early appearance on the globe, fossil remains of roaches occurring in abundance in the early coal formations, ages before the more common forms of insect life of the present day had begun to appear. The species now existing are few in number in comparison with the abundance of forms in the Carboniferous age, which might with propriety be called the age of cockroaches, the moisture and warmth of that distant period being alike favorable to plant growth and to the multiplication of this family of insects.

The house roaches of to-day were undoubtedly very early associated with man in his primitive dwellings, and through the agency of commerce have been carried to all quarters of the globe. On shipboard they are always especially numerous and troublesome, the moisture and heat of the vessels being particularly favorable to their development. It is supposed that the common oriental cockroach, or so-called "black beetle," of Europe [1] is of Asiatic origin, and it is thought to have been introduced into Europe in the last two or three hundred years. The original home of this and the other common European species [2] is, however, obscure, and in point of fact they have probably both been associated with man from the earliest times, and naturally would come into the newly settled portions of Europe from the older civilizations of Asia and Egypt.

Of the other two domestic species especially considered in this paper, the Australian roach,[3] as its name implies, is a native of Australia, and the American roach,[4] of subtropical and tropical America.

[1] *Blatta orientalis* L.
[2] *Blattella germanica* L.
[3] *Periplaneta australasiæ* Fab.
[4] *Periplaneta americana* L.

Rarely do two of the domestic species occur in any numbers together in the same house. Often also of two neighboring districts one may be infested with one species, while in the other a distinct species is the commoner one. The different species are thus seemingly somewhat antagonistic, and it is even supposed that they may prey upon one another, the less numerous species being often driven out.

STRUCTURAL CHARACTERISTICS.

Although among the oldest insects geologically, roaches have not departed notably from the early types, and form one of the most persistent groups among insects. The house species are rather uniformly dark brown or dark colored, a coloration which corresponds with their habit of concealment during daylight. They are smooth and slippery insects, and in shape broad and flattened. The head is inflexed under the body, so that the mouth parts are directed backward and the eyes directed downward, conforming with their groveling habits. The antennæ are very long and slender, often having upward of 100 joints. The males usually have two pairs of wings, the outer ones somewhat coriaceous and the inner ones more membranous and folded once longitudinally. In some species, as, for instance, the black beetle, the females are nearly wingless. The legs are long and powerful and armed with numerous strong bristles or spines. The mouth parts are well developed and have strong biting jaws, enabling these insects to eat all sorts of substances.

HABITS.

In houses roaches are particularly abundant in pantries and kitchens, especially in the neighborhood of fireplaces, on account of the heat. For the same reason they are often abundant in the oven rooms of bakeries or wherever the temperature is maintained above the normal. They conceal themselves during the day behind baseboards, furniture, or wherever security and partial protection from the light are afforded. Their very flat, thin bodies enable them to squeeze themselves into small cracks or spaces where their presence would not be suspected and where they are out of the reach of enemies. Unless routed out by the moving of furniture or disturbed in their hiding places, they are rarely seen, and if so discovered, make off with wonderful celerity, with a scurrying, nervous gait, and usually are able to elude all efforts at their capture or destruction. It may often happen that their presence, at least in the abundance in which they occur, is hardly realized by the housekeeper unless they are surprised in their midnight feasts. Coming into a kitchen or pantry suddenly, a sound of the rustling of numerous objects will come to the ear, and if a light be introduced, often the floor or shelves will be seen covered with scurrying roaches hastening to places of concealment. In districts

where the large American roach occurs they sometimes swarm in this way at night in such numbers that upon entering a small room in which they are congregated one will be repeatedly struck and scratched on the face and hands by the insects in their frantic flight to gain concealment.

The black roach is less active and wary than the others, and particularly the German roach, which is especially agile and shy.

The domestic roaches are practically omnivorous, feeding on almost any dead animal matter, cereal products, and food materials of all sorts. They are also said to eat their own cast skins and egg cases, and it is supposed that they will attack other species of roaches, or are, perhaps, occasionally cannibalistic. They will also eat or gnaw woolens, leather (as of shoes or furniture), and frequently are the cause of extensive damage to the cloth and leather bindings of books in libraries and publishing houses. The sizing or paste used on the cloth covers and in the binding of books is very attractive to them. The surface of the covers of cloth-bound books is often much scraped and disfigured, particularly by the German cockroach,[1] and the gold lettering is sometimes eaten off to get at the albumen paste. On shipboard the damage is often very extensive on account of the vast numbers of cockroaches which frequently occur there, and there are reliable accounts of entire supplies of ship biscuits having been eaten or ruined by roaches.

The damage they do is not only in the products actually consumed, but in the soiling and rendering nauseous of everything with which they come in contact. They leave, wherever they occur in any numbers, a fetid, nauseous odor, well known as the "roachy" odor, which is persistent and can not be removed from shelves and dishes without washing with soap and boiling water. Food supplies so tainted are beyond redemption. This odor comes partly from the excrement, but chiefly from a dark-colored fluid exuded from the mouth of the insect, with which it stains its runways, and also in part, doubtless, from the scent glands, which occur on the bodies of both sexes between certain segments of the abdomen, and which secrete an oily liquid possessing a very characteristic and disagreeable odor. It frequently happens that shelves on which dishes are placed become impregnated with this roachy odor, and this is imparted to and retained by dishes to such an extent that everything served in them, particularly liquids, as coffee or tea, will be noticed to have a peculiar, disgusting, foreign taste and odor, the source of which may be a puzzle, and will naturally be supposed to come from the food rather than from the dish.

The roaches are normally scavengers in habit and may at times be of actual service in this direction by eating up and removing any dead animal material.

[1] *Blattella germanica L.*

One other redeeming trait has been recorded of them, namely, that they will prey upon that other grievous pest of houses which are not subjected to careful supervision, the bedbug. Their habits in this direction have been recorded several times. One writer, in a narrative of a voyage,[1] makes the following statement in this connection:

> Cockroaches, those nuisances to ships, are plentiful at St. Helena, and yet, bad as they are, they are more endurable than bugs. Previous to our arrival here in the *Chanticleer*, we had suffered great inconvenience from the latter, but the cockroaches no sooner made their appearance than the bugs entirely disappeared. The fact is that the cockroach preys upon them and leaves no sign or vestige of where they have been; so far it is a most valuable insect.[2]

The cockroach is, however, far too much of a nuisance itself to warrant its being recommended as a means of eradicating even the much more disagreeable insect referred to.[3]

The local spread of roaches from house to house is undoubtedly often effected by their introduction with supplies, furniture, goods, etc. That the Croton bug, or German roach, and probably the other species also, may develop a migratory instinct has been witnessed by Dr. Howard and the writer in Washington.[4] This very interesting instance of what seems to have been a true migration, in which an army of thousands of roaches by one common impulse abandoned their old quarters and started on a search for a more favorable location, illustrates, as pointed out by Dr. Howard, what is probably of frequent occurrence under the cover of darkness, and accounts for the way in which new houses frequently become suddenly overrun with these vermin.

TRANSFORMATION.

The roach in its different stages from egg to adult shows comparatively little variation in appearance or habits. The young are very much like the adults, except in point of size and in lacking wings, if the latter be winged in the adult state. In their mode of oviposition

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[1] Foster, Henry. Narrative of a voyage to the Southern Atlantic Ocean in the years 1828, 29, 30, v. 1, p. 373-374, London, 1834.

[2] Proc. Ent. Soc. Lond., 1855, n. s. v. 3, p. 77.

[3] The following interesting letter from Mr. Herbert H. Smith, the collector and naturalist, gives a vivid picture of the roach nuisance in the Topics:

> Cockroaches are so common in Brazilian country houses that nobody pays any attention to them. They have an unpleasant way of getting into provision boxes, and they deface books, shoes, and sometimes clothing. Where wall paper is used they soon eat it off in unsightly patches, no doubt seeking the paste beneath. But at Corumba, on the upper Paraguay, I came across the cockroach in a new rôle. In the house where we were staying there were nearly a dozen children, and everyone of them had their eyelashes more or less eaten off by cockroaches—a large brown species, one of the commonest kind throughout Brazil. The eyelashes were bitten off irregularly, in some cases quite close to the lid. Like most Brazilians, these children had very long, black eyelashes, and their appearance thus defaced was odd enough. The trouble was confined to children, I suppose because they are heavy sleepers and do not disturb the insects at work. My wife and I sometimes brushed cockroaches from our faces at night, but thought nothing more of the matter. The roaches also bite off bits of the toenails. Brazilians very properly encourage the large house spiders, because they tend to rid the house of other insect pests.

[4] U. S. Dept. Agr., Div. Ent., Insect Life, v. 7, no. 4, p. 349, March, 1895.

they present, however, a very anomalous and peculiar habit. The eggs, instead of being deposited separately, as with most other insects, are brought together within the abdomen of the mother into a hard, horny pod or capsule which often nearly fills the body of the parent. This capsule contains a considerable number of eggs, the number varying in the different species, arranged in two rows, the position of the eggs being indicated on the exterior of the capsule by transverse lateral impressions. When fully formed and charged with eggs the capsule is often partly extruded from the female abdomen and retained in this position sometimes for weeks, or until the young larvæ are ready to emerge. The capsule is oval, elongate, or somewhat bean shaped, and one of its edges is usually serrate. The young are in some instances assisted to escape by the parent, who with her feet aids in splitting the capsule on the serrate edge to facilitate their exit. On hatching, it is said the young are often kept together by the parent and brooded over and cared for, and at least a colony of young will usually be found associated with one or two older individuals. These insects are more or less gregarious, notably so in the case of the black beetle of Europe and to a less extent with the German and American roaches.

FIG. 2.—Egg capsule of *Periplaneta americana*: *a*, Side; *b*, end view. Natural size indicated by outline figure. (Author's illustration.)

They pass through a variable number of molts, sometimes as many as seven, the skin splitting along the back and the insects coming out white, soft, but rapidly hardening and assuming the normal color. Some astounding statements have been made as to the length of time required for the development of the roach from the egg to the adult. Four or five years have been said to be necessary for an individual to reach full growth; but more recent breeding experiments have not altogether confirmed these statements. Their development, however, is unquestionably slow, and probably under the most favorable conditions rarely is more than one generation per year produced. In colder countries the breeding and growth are practically restricted to the warm season. During the winter months they go into concealment and partial hibernation. *Blattella germanica* has been shown to reach full growth in a variable period of from four and a half to six months.[1] The common American roach [2] has been carried from the egg to the adult state in the insectary. Young hatching July 11 from an egg case received from Eagle Pass, Tex., reached the adult stage between March 14 and June 12 of the following year, indicating a period of nearly 12 months for complete development. The rate of growth of the roach undoubtedly depends

[1] Hummel, Essais Entomologiques, No. 1, St. Petersburg, 1821.

[2] *Periplaneta americana* L.

very largely on food and temperature, and under unfavorable conditions the time required for development may undoubtedly be vastly lengthened. The abundance of roaches is, therefore, apparently not accounted for so much by their rapidity of multiplication as by their unusual ability to preserve themselves from ordinary means of destruction and by the scarcity of natural enemies.

THE COMMON DOMESTIC ROACHES.

The four roaches which have been made the subject of illustrations represent the species which occur most commonly in houses, bakeries, or on shipboard. The numerous tropical house species, many of which are perhaps only partially domesticated, and the subarctic roach of high altitudes and of the extreme north have been omitted.

The American roach [1] (fig. 1) is the native or indigenous species of this continent, originating, it is supposed, in tropical or subtropical America.

An ancient and rather quaint account of the American roach indicates that this species early came to the notice of our forefathers.[2] Its domesticity doubtless resulted from ages of association with the aborigines. It has now become thoroughly cosmopolitan and is unquestionably the most injurious and annoying of the species occurring on vessels. It is sometimes numerous also in greenhouses, causing considerable injury to tender plants. It is a notorious house pest and occasionally vies with the German roach in its injuries to book bindings. One of the most serious cases of injury of this sort was reported by the Treasury Department. The backs of both cloth and leather bound books were sometimes entirely eaten off to get at the starchy paste used in the binding.[3]

This roach is very abundant in the Middle and Western States, where until recently it has been practically the only troublesome house species. In the East it is not often so common as are one or other of the following species, and especially *germanica*. In foreign countries it has not become widespread and is largely confined to seaport towns. In size it is larger than any of the other domestic species, and it is light brown in color, the wings being usually long, powerful, and well developed in both sexes.

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[1] *Periplaneta americana* L.

[2] *The cockroach.*—These are very troublesome and destructive vermin, and are so numerous and voracious that it is impossible to keep victuals of any kind from being devoured by them without close covering. They are flat, and so thin that few chests or boxes can exclude them. They eat not only leather, parchment, and woolen, but linen and paper. They disappear in winter and appear most numerous in the hottest days in summer. It is at night they commit their depredations, and bite people in their beds, especially children's fingers that are greasy. They lay innumerable eggs, creeping into the holes of old walls and rubbish, where they lie torpid all the winter. Some have wings and others are without—perhaps of different sexes.—Catesby, Mark. Natural history of Carolina, Florida, and the Bahama Islands, v. 2, Appendix, p. 10, London, 1748.

[3] U. S. Dept. Agr., Div. Ent., Insect Life, v. 1, no. 3, p. 67–70, September, 1888.

The Australian roach[1] (fig. 3) resembles very closely the last species, but differs strikingly in the brighter and more definitely limited yellow band on the prothorax and in the yellow dash on the sides of the upper wings. In the United States it is the most abundant and troublesome species in Florida and some of the other Southern States. It is already practically cosmopolitan.

The oriental cockroach, or "black beetle,"[2] is the common European and particularly the English species, and is notable for the fact that the female is nearly wingless in the adult state. The wings of the male also are shortened, not reaching to the extremity of the body.

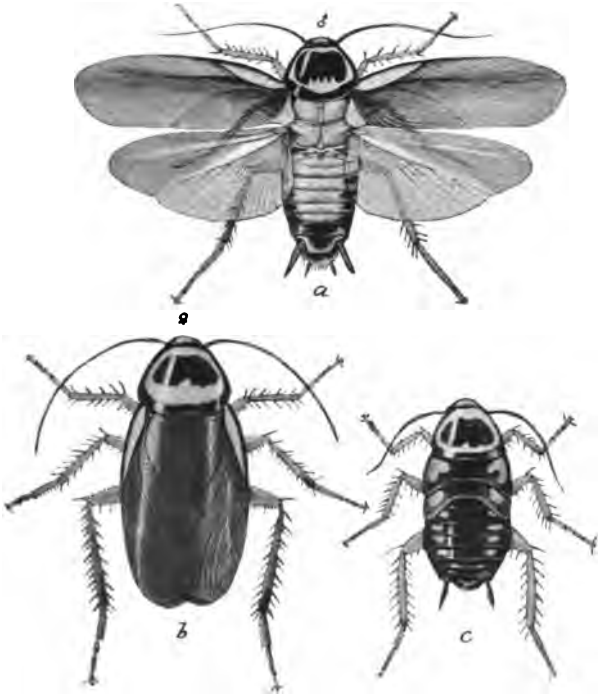

FIG. 3.—The Australian roach (*Periplaneta australasiæ*): *a*, Male with spread wings; *b*, female; *c*, pupa. All life size. (Author's illustration.)

In color it is very dark brown, almost black, shining, and rather robust, much stouter than the other species, making its English name of "black beetle" quite appropriate. This species is notably gregarious in habit, individuals living together in colonies in the most amicable way, the small ones being allowed by the larger ones to sit on them, run over them, and nestle beneath them without any resentment being shown. This species was a common and troublesome pest in the British colonies early in the eighteenth century, although unknown at the same time in the French Canadian possessions.[3]

[1] *Periplaneta australasiæ* Fab.
[2] *Blatta orientalis* L.
[3] Kalm, Peter. Travels into North America, ed. 2, v. 1, p. 321-323; v. 2, p. 256. London, 1772.

It then seemed to be commonly known as the mill beetle. The early Dutch called them *Kakerlach*, and in the Swede settlements they were known as *Brodætare* (bread eaters). It is now very common in houses in the East, but is quite generally distributed, and is the common species even so far removed from the Atlantic seaboard as New Mexico. The characteristics of this insect are shown in the accompanying illustration (fig. 4).

The German cockroach [1] is particularly abundant in Germany and neighboring European countries, but, like most of the other domestic species, has become world-wide in distribution. In this country it is very often styled the Croton bug, this designation coming from the fact, already alluded to, that attention was first permanently

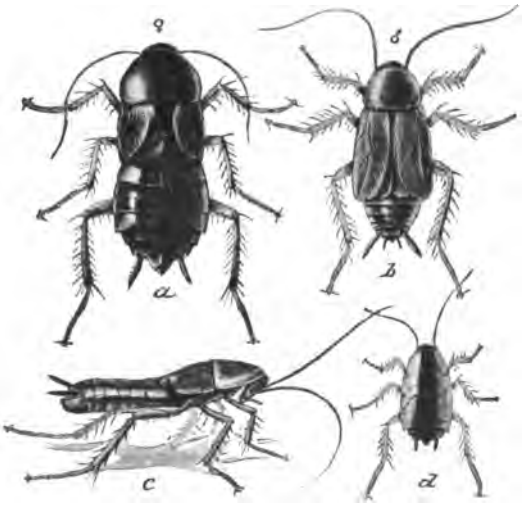

FIG. 4.—The Oriental roach (*Blatta orientalis*): *a*, Female; *b*, male; *c*, side view of female; *d*, half-grown specimen. All natural size. (Author's illustration.)

drawn to it at the time of the completion of the Croton system of waterworks in New York City. It had probably been introduced long previously, but the extension of the waterworks system and of piping afforded it means of ingress into residences and greatly encouraged its spread and facilitated its multiplication. The dampness of water pipes is favorable to it, and it may be carried by the pressure of the water long distances through the pipes without injury. This roach has so multipled in the eastern United States that it has now become the commonest and best known of the domestic species, and its injuries to food products, books, etc., and the disgusting results of its presence in pantries, storehouses, and bakeries give it really a greater economic importance than any of the other species.

[1] *Blattella germanica* L.

It is very light brown in color, and characteristically marked on the thorax with two dark-brown stripes. It is more active and wary than the larger species and much more difficult to eradicate. It is the smallest of the domestic species, rarely exceeding five-eighths of an inch in length, and multiplies much more rapidly than the others, the breeding period being shorter and the number of eggs in the capsules greater than with the larger roaches. The injuries effected by it to cloth-bound reports have been the source of very considerable annoyance at the Department of Agriculture and in the large libraries of

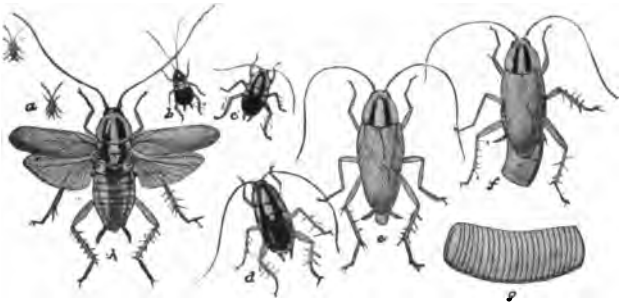

FIG. 5.—The German roach (*Blattella germanica*): *a*, First stage; *b*, second stage; *c*, third stage; *d*, fourth stage; *e*, adult; *f*, adult female with egg case; *g*, egg case, enlarged; *h*, adult with wings spread. All natural size except *g*. (From Riley.)

eastern towns and colleges. The characteristics of the different stages, from the egg to the adult, are shown in the illustration (fig. 5).

NATURAL ENEMIES AND PARASITES.

In Europe the egg capsules of the cockroach are often parasitized by an ichneumon fly.[1] This insect has become widely distributed over the world following its host insect, and has been redescribed under a great many different names. It was found in Cuba as early as 1829, and has been several times collected in the United States. Unfortunately, its usefulness as a means of keeping the roach in check by destroying the egg capsules is greatly impaired by the occurrence of another ichneumon fly,[2] which is parasitic upon the first. This is also a European species which has been brought over with its host parasite. If the true egg-capsule parasite of the roach could have been introduced into this country without this secondary parasite its usefulness would doubtless have been very much greater. The secondary parasite, however, seems to have been introduced early, and has been found in Cuba and Florida, and probably occurs as widely as its host and prevents the latter from multiplying very greatly. Among other natural enemies of the roach are tree frogs; and a correspondent informs us that if these animals are inclosed in a room overnight they will effectively clear it of roaches.

[1] *Evania appendigaster* L.

[2] *Entedon hagenowi* Ratzb.

REMEDIES.

Like the crows among birds, the roaches among insects are apparently unusually well endowed with the ability to guard themselves against enemies, displaying great intelligence in keeping out of the way of the irate housekeeper and in avoiding food or other substances which have been doctored with poison for their benefit. Their keenness in this direction may be the accumulated inheritance of many centuries during which the hand of man has ever been raised against them. Roaches may be controlled by the use of (1) poisons and repellents; (2) fumigants; and (3) trapping.

POISONS AND REPELLENTS.

As just noted, roaches often seem to display a knowledge of the presence of poisons in food, and, notwithstanding their practically omnivorous habits, a very little arsenic in baits seems to be readily detected by them. In attempting to eradicate roaches from the department storerooms where cloth-bound books are kept various paste mixtures containing arsenic were tried, but the roaches invariably refused to feed on them in the least. This applies particularly to the German roach, or Croton bug, and may not hold so strongly with the less wary and perhaps less intelligent larger roaches.

Sodium fluorid.—One of the most effective simple means of ridding premises of roaches is dusting with commercial sodium fluorid, either pure or diluted one-half with some inert substance such as powdered gypsum or flour. Numerous practical tests conducted in lunch rooms, bakeries, milk-bottle exchanges, etc., in Washington by Messrs. E. W. Scott, W. S. Abbott, and W. H. Sill, working under the direction of Mr. A. L. Quaintance, of the Bureau of Entomology of this department, have shown that with the use of this substance roaches can be completely exterminated with very little trouble and cost and with none of the possible dangers which attend the use of hydrocyanic-acid gas, another efficient control method referred to below under the subject of fumigation. With the use of some dust gun or blower the sodium fluorid can be thoroughly dusted over the shelves, tables, floors, and the runways and hiding places of the roaches. The immediate effect is to cause these insects to come out of their retreats and rush about more or less blindly, showing evidence of discomfort, to be eventually followed in the course of a few hours by their death. These dead or paralyzed roaches can be swept up and burned, and complete extermination is effected within 24 hours. It is not definitely known whether the sodium fluorid acts as a contact insecticide through the breathing pores or as a stomach poison. Probably, however, it acts in both ways, inasmuch as it has been found to kill caterpillars fed on foliage dusted with this substance.

Borax.—Powdered borax enters into the composition of many of the so-called roach powders. This substance may be used either pure as a poison or repellent or mixed with some other substance to render it attractive to the insects. Several correspondents have reported great success from the use of a mixture consisting of 1 part powdered borax to 3 parts of finely pulverized chocolate, this mixture to be freely sprinkled about the infested premises.

Pyrethrum.—Another common remedy consists in the liberal use of pyrethrum powder or buhach. This is at best but a temporary expedient, but if persisted in considerable relief will be gained. To be at all effective it must be fresh and liberally applied. The roaches are often paralyzed by it rather than killed outright, and the morning after the application all paralyzed and dead roaches should be swept up and burned.

Sulphur.—Flowers of sulphur dusted about where roaches abound has also proved, on the authority of Mr. A. I. Mudd, of this department, very effective as a repellent.

Phosphorus.—Of the proprietary substances, perhaps one of the oldest and most efficient is a form of phosphorus paste. It consists of sweetened flour paste containing 1 to 2 per cent of phosphorus, and may be distributed on bits of paper or cardboard placed in the runways of the roaches. It has been used very successfully in the offices of this department to free desks from Croton bugs, numbers of dead insects being found in the drawers every day during the time the poison was kept about. It also has some repellent value.

FUMIGANTS.

Hydrocyanic-acid gas.—Hydrocyanic-acid gas fumigation is a thoroughly effective means of ridding premises of roaches, but involves considerable cost, difficulty of application, and the necessity of taking extreme precautions on account of the deadly nature of the gas to higher animals, including human beings. A special publication, which may be had on application, has been issued by the Department of Agriculture giving the steps of the process in detail.

Carbon bisulphid.—Wherever roaches infest small rooms or apartments which may be sealed up nearly air-tight, and also on shipboard, the roach nuisance can be greatly abated by the proper use of carbon bisulphid. This substance, distributed about a pantry or room in open vessels, will evaporate, and, if used at the rate of 1 pound to every 1,000 cubic feet of room space, will destroy roaches. Unless the room can be very tightly sealed up, however, the vapor dissipates so rapidly that its effect will be lost before the roaches are killed. The hatches of ships, especially of smaller coasting vessels, may be battened down, a very liberal application of carbon bisulphid having been previously made throughout the interior. If left for 24 hours

the roaches and all other vermin will unquestionably have been destroyed. *In the use of this substance it must be always borne in mind that it is violently explosive in the presence of fire, and every possible precaution should be taken to see that no fire is in or about the premises during the treatment.* It is also deadly to higher animals, and compartments should be thoroughly aired after fumigation.

Pyrethrum fumes.—A safer remedy of the same nature consists in burning pyrethrum in the infested apartment. The smoke and vapors generated by the burning of this insecticide are often more effective in destroying roaches than the application of the substance in the ordinary way as a powder. There is no attendant danger of explosion, and the only precaution necessary is to see that the room is kept tightly closed for from 6 to 12 hours.

TRAPPING.

Various forms of traps have been very successfully employed in England and on the Continent of Europe as a means of collecting and destroying roaches. These devices are all so constructed that the roaches may easily get into them and can not afterwards escape. The destruction of the roaches is effected either by the liquid into which they fall or by dousing them with hot water. A few of the common forms of traps and the methods of using them are here described.

A French trap consists of a box containing an attractive bait, the cover of which is replaced by four glass plates inclined toward the center. The roaches fall from the covering glasses into the box and are unable to escape. A similar trap used in England is described by Westwood. It consists of a small wooden box in which a circular hole is cut in the top and fitted with a glass ring, so that it is impossible for the roaches to escape. This trap is baited nightly, and the catch thrown each morning into boiling water.

A simpler form of trap, which the late F. C. Pratt reported as being very successfully used in London, England, consists of any deep vessel or jar, against which a number of sticks are placed, and bent over so that they project into the interior of the vessel for a few inches. The vessel is partially filled with stale beer or ale, a liquid for which roaches seem to have a special fondness. In the morning these vessels are found charged with great quantities of dead and dying roaches, which have climbed up the inclined sticks and slipped off into the vessel. This last method has given fairly successful results against the Oriental roach in Washington, but against the more wary and active Croton bug it is comparatively worthless.

A simple and practical method of trapping roaches in large numbers was devised by a correspondent in Brockton, Mass. He took several tin bread pans with nearly vertical sides about 3 inches in height,

greased the bottoms and sides with a little rancid butter, and placed them where the roaches were numerous. Each pan in the morning contained hundreds of the pests unable to climb out because of the greased sides. The roaches were shaken out into hot water, and the pans were again ready for use, without regreasing.

Traps of the sort described above, placed in pantries and bakeries, will unquestionably destroy great quantities of roaches, and keep them in check and thus obviate the use of insect powders or the distribution of poisoned baits.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 659 APRIL 5, 1915.

Contribution from the Bureau of Entomology, L. O. Howard, Chief.

THE TRUE CLOTHES MOTHS.[1]

By C. L. MARLATT,

Entomologist and Acting Chief in Absence of Chief.

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INTRODUCTION.

The destructive work of the larvæ of the small moths commonly known as clothes moths, and also as carpet moths, fur moths, etc., in woolen fabrics, fur, and similar material during the warm months of summer in the North, and at any season in the South, is an altogether too common experience. The preference they so often show for woolen or fur garments gives these insects a much more general interest than is perhaps true of any other household pest.

The little yellowish or buff-colored moths sometimes seen flitting about rooms, attracted to lamps at night, or dislodged from infested garments or portieres, are themselves harmless enough, and in fact their mouth parts are rudimentary, and no food whatever is taken in the winged state. The destruction occasioned by these pests is,

[1] A reprint, with slight revision, of Circular No. 36, Bureau of Entomology, U. S. Dept. of Agriculture.

NOTE.—This bulletin is of interest to housekeepers and those who have anything to do with fur and wool, in either the raw or the manufactured state.

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therefore, limited entirely to the feeding or larval stage. The killing of the moths by the aggrieved housekeeper, while usually based on the wrong inference that they are actually engaged in eating her woolens, is, nevertheless, a most valuable proceeding, because it checks in so much the multiplication of the species, which is the sole duty of the adult insect.

The clothes moths all belong to the group of minute Lepidoptera known as Tineina, the old Latin name for cloth worms of all sorts, and are characterized by very narrow wings fringed with long hairs. The common species of clothes moths have been associated with man from the earliest times and are thoroughly cosmopolitan. They are all probably of Old World origin, none of them being indigenous to the United States. That they were well known to the ancients is shown by Job's reference to "a garment that is moth eaten," and Pliny has given such an accurate description of one of them as to lead to the easy identification of the species. That they were early introduced into the United States is shown by Pehr Kalm, a Swedish scientist, who took a keen interest in house pests. He reported these tineids to be abundant in 1748 in Philadelphia, then a straggling village, and says that clothes, worsted gloves, and other woolen stuffs hung up all summer were often eaten through and through by the worms, and furs were so ruined that the hair would come off in handfuls.

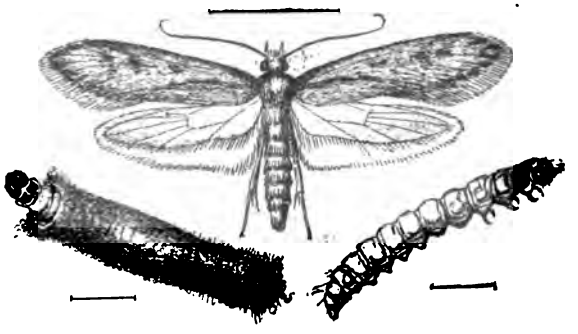

FIG. 1.—*Tinea pellionella:* Above, adult; at right, larva; at left, larva in case. Enlarged. (From Riley.)

What first led to the association of these and other household pests with man is an interesting problem. In the case of the clothes moths, the larvæ of all of which can, in case of necessity, still subsist on almost any dry animal matter, their early association with man was probably in the rôle of scavengers, and in prehistoric times they probably fed on waste animal material about human habitations and on fur garments. The fondness they exhibit nowadays for tailor-made suits and other expensive products of the loom is simply an illustration of their ability to keep pace with man in his development in the matter of clothing from the skin garments of savagery to the artistic products of the modern tailor and dressmaker.

Three common destructive species of clothes moths occur in this country. Much confusion, however, exists in all the early writings on these insects, all three species being inextricably mixed in the

descriptions and accounts of habits. Collections of these moths were submitted some years ago by Profs. Fernald and Riley to Lord Walsingham, of Merton Hall, England, the world's authority on tineids, and from the latter's careful diagnosis it is now possible to separate and recognize the different species easily.

The common injurious clothes moths are the case-making species,[1] the webbing species or southern clothes moth,[2] and the gallery species or tapestry moth.[3]

A few other species, which normally infest animal products, may occasionally also injure woolens, but are not of sufficient importance to be noted here.

THE CASE-MAKING CLOTHES MOTH.

The case-making clothes moth [1] (fig. 1) is the only species which constructs for its protection a true transportable case. It was characterized by Linnæus, and carefully studied by Réaumur, early in the last century. Its more interesting habits have caused it to be often a subject of investigation, and its life history will serve to illustrate the habits of all the clothes moths.

The moth expands about half an inch, or from 10 to 14 millimeters. Its head and forewings are grayish yellow, with indistinct fuscous spots on the middle of the wings. The hind wings are white or grayish and silky. It is the common species in the North, being widely distributed and very destructive. Its larva feeds on woolens, carpets, etc., and is especially destructive to furs and feathers. In the North it has but one generation annually, the moths appearing from June to August, and, on the authority of Prof. Fernald, even in rooms kept uniformly heated night and day it never occurs in the larval state in winter. In the South, however, it appears from January to October, and has two or even more broods annually.

The larva is a dull white caterpillar, with the head and the upper part of the next segment light brown, and is never seen free from its movable case or jacket, the construction of which is its first task. If it be necessary for it to change its position, the head and first segment are thrust out of the case, leaving the thoracic legs free, with which it crawls, dragging its case after it, to any suitable situation. With the growth of the larva it becomes necessary from time to time to enlarge the case both in length and circumference, and this is accomplished in a very interesting way. Without leaving its case the larva makes a slit halfway down one side and inserts a triangular gore of new material. A similar insertion is made on the opposite side, and the larva reverses itself without leaving the case and makes corresponding slits and additions in the other half. The case is lengthened by successive

[1] *Tinea pellionella* L. [2] *Tineola biselliella* Hummel. [3] *Trichophaga tapetzella* L.

additions to either end. Exteriorly the case appears to be a matted mass of small particles of wool; interiorly it is lined with soft whitish silk. By transferring the larva from time to time to fabrics of different colors the case may be made to assume as varied a pattern as the experimenter desires, and will illustrate, in its coloring, the peculiar method of making the enlargements and additions described.

On reaching full growth the larva attaches its case by silken threads to the garment or other material upon which it has been feeding, or sometimes carries it long distances. In one instance numbers of them were noticed to have scaled a 15-foot wall to attach their cases in an angle of the cornice of the ceiling. It undergoes its transformations to the chrysalis within the larval case, and under normal conditions the moth emerges three weeks later, the chrysalis having previously worked partly out of the larval case to facilitate the escape of the moth. The latter has an irregular flight and can also run rapidly. It has a distinct aversion to light, and usually conceals itself promptly in garments or crevices whenever it is frightened from its resting place. The moths are comparatively short-lived, not long surviving the deposition of their eggs for a new generation of destructive larvæ. The eggs are minute, not easily visible to the naked eye, and are commonly placed directly on the material which is to furnish the larvæ with food. In some cases they may be deposited in the crevices of trunks or boxes, the newly hatched larvæ entering through these crevices.

In working in feathers this insect occasionally causes a felting very similar to that produced by the black carpet beetle, *Attagenus piceus* Oliv.

The protection afforded by the seclusion of this insect in houses does not prevent its having insect enemies, and at least two hymenopterous parasites have been reared in this country from its larval cases. These are *Exochus ovatus* Davis and *Apanteles carpatus* Say, both reared from specimens collected in Michigan.

THE WEBBING, OR SOUTHERN CLOTHES MOTH.

The webbing, or Southern clothes moth [1] (fig. 2) is the more abundant and injurious species in the latitude of Washington and southward. It occurs also farther north, though in somewhat less numbers than the preceding species. It presents two broods annually even in the Northern States, the first appearing in June from eggs deposited in May, and the second in August and September. It is about the size of *pellionella*. The forewings are, however, uniformly pale ocherous, without markings or spots. Its larva feeds on a large variety of animal substances—woolens, hair, feathers, furs, and in England it has even been observed to feed on cobwebs in the corners of rooms,

[1] *Tinecola biselliella* Hummel.

and in confinement has been successfully reared on this rather dainty food substance. The report that it feeds on dried plants in herbaria is rather open to question, as its other recorded food materials are all of animal origin.

Frequently this species is a very troublesome pest in museums, particularly in collections of the larger moths. Prof. F. M. Webster, of the Bureau of Entomology, once had some of his large moths badly riddled by its larvæ, and Hagen also records it as feeding on insect collections. Riley reared it in conjunction with the Angoumois grain moth [1] from grain, it being apparent that its larvæ had subsisted on dead specimens of the grain moth. It is very likely to attack large Lepidoptera on the spreading board, and has, in fact, been carried through several generations on dried specimens of moths.

Its general animal-feeding habit is further indicated by the interesting case reported by Dr. J. C. Merrill, U. S. A., who submitted a sample can of beef meal which had been rejected as "weevilly." The damage proved to be due to the larvæ of *Tineola biselliella*, and goes to substantiate the theory already advanced that clothes moths were scavengers in their earliest association with man.

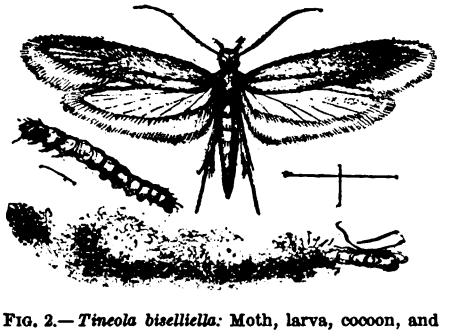

FIG. 2.—*Tineola biselliella:* Moth, larva, cocoon, and empty pupa skin. Enlarged. (From Riley.)

The larva of this moth constructs no case, but spins a silky, or more properly cobwebby, path wherever it goes. When full grown it builds a cocoon of silk, intermixed with bits of wool, resembling somewhat the case of *pellionella*, but more irregular in outline. Within this it undergoes its transformation to the chrysalis, and the moth in emerging leaves its pupal shell projecting out of the cocoon as with the preceding species.

THE TAPESTRY MOTH.

The tapestry moth [2] (fig. 3) is rare in the United States. It is much larger than either of the other two species, measuring three-fourths inch in expansion of wings, and is more striking in coloration. The head is white, the basal third of the forewings black, with the exterior two-thirds of a creamy white, more or less obscured on the middle with gray; the hind wings are pale gray.

This moth normally affects rather coarser and heavier cloths than the smaller species and is more apt to occur in carpets, horse blankets, and

[1] *Sitotroga cerealella* Oliv. [2] *Trichophaga tapetzella* L.

tapestries than in the finer and thinner woolen fabrics. It also affects felting, furs, and skins, and is a common source of damage to the woolen upholstering of carriages, being rather more likely to occur in carriage houses and barns than in dwelling houses. Its larva enters directly into the material which it infests, constructing burrows or galleries, which it lines more or less completely with silk. Within these galleries it is protected and concealed during its larval life, and later undergoes its transformations without other protection than that afforded by the gallery. The damage is due as much or more to its burrowing than to the actual amount of the material consumed for food.

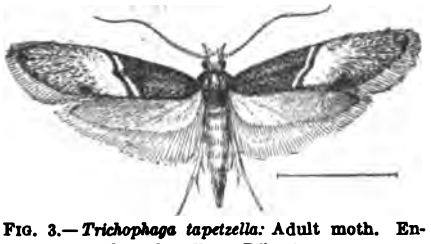

FIG. 3.—*Trichophaga tapetzella:* Adult moth. Enlarged. (From Riley.)

One of the parasites, *Apanteles carpatus* Say, reared from *Tinea pellionella*, has also been reared from the tapestry moth at St. Louis, Mo.

REMEDIES.

There is no easy method of preventing the damage done by clothes moths, and to maintain the integrity of woolens or other materials which they are likely to attack demands constant vigilance, with frequent inspection and treatment. In general, they are likely to affect injuriously only articles which are put away and left undisturbed for some little time. Articles in daily or weekly use, and apartments frequently aired and swept, or used as living rooms, are not apt to be seriously affected. Carpets under these conditions are rarely attacked, except sometimes around the borders, where the insects are not so much disturbed by walking and sweeping. Agitation, such as beating, shaking, or brushing, and exposure to air and sunlight, are old remedies and still among the best at command. Various repellents, such as tobacco, camphor, naphthaline cones or balls, and cedar chips or sprigs, have a certain value if the garments are not already stocked with eggs or larvæ. The odors of these repellents are so disagreeable to the parent moths that they are not likely to come to deposit their eggs as long as the odor is strong. As the odor weakens the protection decreases, and if the eggs or larvæ are already present, these odors have no effect on their development; while if the moths are inclosed with the stored material to be protected by these repellents, so that they can not escape, they will of necessity deposit their eggs, and the destructive work of the larvæ will be little, if at all, restricted. After woolens have been given a vigorous and thorough treatment and aired and exposed to sunlight, however, it is of some advantage in packing them away to inclose with them any of the repellents mentioned. Cedar chests and wardrobes are of value in proportion to the

freedom of the material from infestation when stored away; but, as the odor of the wood is largely lost with age, in the course of a few years the protection greatly decreases. Furs and such garments may also be stored in boxes or trunks which have been lined with heavy tar paper used in buildings. New papering should be given to such receptacles every year or two. Similarly, the tarred paper moth bags obtainable at dry-goods houses are of some value; always, however, the materials should first be subjected to the treatment outlined above.

To protect carpets, clothes, and cloth-covered furniture, furs, etc., these should be thoroughly beaten, shaken, brushed, and exposed as long as practicable to the sunlight in early spring, either in April, May, or June, depending on the latitude. The brushing of garments is a very important consideration, to remove the eggs or young larvæ which might escape notice. Such material can then be hung away in clothes closets which have been thoroughly cleaned, and, if necessary, sprayed with benzine about the cracks of the floor and the baseboards. If no other protection be given, the garments should be examined at least once a month during summer, brushed, and, if necessary, exposed to the sunlight.

It would be more convenient, however, so to inclose or wrap up such material as to prevent the access of the moths to it, after it has once been thoroughly treated and aired. This can be easily effected in the case of clothing and furs by wrapping tightly in stout paper or inclosing in well-made bags of cotton or linen cloth or strong paper. Dr. L. O. Howard has adopted a plan which is inexpensive, and which he has found eminently satisfactory. For a small sum he secures a number of the large pasteboard boxes, such as tailors use, and in these packs away all winter clothing, gumming a strip of wrapping paper around the edge, so as to seal up the box completely and leave no cracks. These boxes with care will last many years. With thorough preliminary treatment it will not be necessary to use the tar-impregnated paper sacks sold as moth protectors, which may be objectionable on account of the odor.

In the case of furniture or carriages, covered or lined with woolen cloth, stored or left unused for the summer, examination and thorough brushing should be given at least monthly. Spraying monthly with benzine or naphtha or sponging with dilute corrosive sublimate has been recommended, but due regard should be given to the inflammability of these sprays and to the poisonous nature of the corrosive sublimate.

The method of protection adopted by one of the leading furriers of Washington, D. C., who also has a large business and experience in storing costly furs, etc., is practically the course already outlined. Furs when received are first most thoroughly and vigorously beaten with small sticks, to dislodge all loosened hair and the larvæ or moths.

They are then gone over carefully with a steel comb and packed away in large boxes lined with heavy tar roofing paper, or in closets similarly lined with this paper. An examination is made every two to four weeks, and, if necessary at any time, any garment requiring it is rebeaten and combed. During many years of experience in this climate, which is especially favorable to moth damage, this merchant has prevented any serious injury from moths.

COLD STORAGE.

The best method of protection, and the one now commonly adopted by dealers in carpets, furs, etc., is cold storage. In all large towns anyone can avail himself of this means by patronizing storage companies, and safety will be guaranteed.

The most economical degree of cold to be used as a protection from clothes moths and allied insects destructive to woolens and furs has been definitely determined by the careful experiments carried out at the instance of Doctor Howard by Dr. Albert M. Read, manager of a large storage warehouse company in Washington, D. C. These experiments demonstrated that a temperature maintained at 40° F. renders the larval or other stages of these insects dormant and is thoroughly effective. The larvæ, however, are able to stand a steady temperature as low as 18° F. without apparently experiencing any ill results. Doctor Read's experiments have extended over two years, and his later results as reported by Doctor Howard are very interesting. They have demonstrated that while a temperature kept uniformly at 18° F. will not destroy the larvæ of *Tineola biselliella* or of the black carpet beetle,[1] "an alternation of a low temperature with a comparatively high one invariably results in the death of the larvæ of these two insects. For example, if larvæ of either which have been kept at a temperature of 18° F. are removed to a temperature of 40° to 50° F., they will become slightly active and, when returned to the lower temperature and kept there for a little time, will not revive upon a retransfer to the warmer temperature."

It is recommended, therefore, that storage companies submit goods to two or three changes of temperature as noted before placing them permanently in an apartment kept at a temperature of from 40° to 42° F. The maintenance of a temperature lower than the last indicated is needless and a wasteful expense. Where the cost of cold storage is not an item to be seriously considered, the adoption of this method for protection of goods during the hot months is strongly recommended.

[1] *Attagenus piceus* Oliv.

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FARMERS' BULLETIN

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Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.

WEEDS: HOW TO CONTROL THEM.

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INTRODUCTION.

In a sense, farming might be called a warfare against weeds. Some farmers emerge from the struggle victorious, while others go down to defeat. So powerful are weed enemies in reducing crop yields, while at the same time multiplying labor, that the farmer should at every turn strengthen his position against them. He should bear these invaders in mind in planning the crops he will grow and in deciding on the fields where he will grow these crops, in choosing the implements he will use, in buying his seed, and in many other farm activities. Lack of careful planning with reference to weeds is apparent in nearly every community. Here a man planted out more corn than he could properly care for. There a man has left his field in meadow too many years. Here a man did not thoroughly prepare his land for alfalfa. There a man has seeded clover that was full of weed seeds. And for just such causes weeds not only make serious

inroads on the current crop yields, but at the same time thoroughly infest the land and fortify themselves against future attacks.

The importance of keeping weeds in subjection can not be emphasized too strongly. It has been shown in experiments with corn made by the United States Department of Agriculture that weed eradication is the principal, if not the only, beneficial result of cultivating this crop after planting.[1] This means that in cultivating the corn crop the implements used should be designed primarily for accomplishing the destruction of weeds in the easiest and cheapest way. It seems to indicate, further, that as weed control becomes more thorough, intercultural tillage of growing crops may be accordingly decreased.

Some men do not attack weeds with enough vigor; they look for rocking-chair methods of work. There is no royal road to weed control. In the main, the old doctrine of "hard work and plenty of it" must be observed, but unless this work is applied intelligently a vast amount of labor may be expended with but little accomplished other than a temporary abatement of the evil.

It may be seen, therefore, that thought as well as work is a requisite in the control of weeds. It is with the idea of directing thought to this important subject that this bulletin has been prepared.

There are three main principles of weed control. It is believed that an understanding of these principles and the methods by which they may be put into practice, as given in the following pages, will greatly lessen the amount of work required to subdue weeds.

WHAT IS A WEED?

A weed has been defined as a plant out of place. This definition is not entirely satisfactory, for two reasons: (1) Because a plant may be out of place and still not be a weed in the popular sense, as rye growing in a wheat field or Kentucky bluegrass in an alfalfa field, and (2) because a plant may not be out of place and still be a weed in popular language, as is described in a subsequent section of this bulletin on the good points about weeds. In reality a weed is a wild plant that has the habit of intruding where not wanted.

Weeds, even under adverse conditions, are able to maintain their existence. In doing this a variety of methods are used. Some weeds produce immense quantities of seeds; some mature seeds in a very short time; some have seeds which are difficult to separate from crop seeds; some possess roots or rootstocks that live for a number of years. It may be seen, therefore, that weeds persist because they are well equipped by nature in one or more ways to hold their own in the struggle for existence.

[1] Cates, J. S., and Cox, H. R. The weed factor in the cultivation of corn. U. S. Department of Agriculture, Bureau of Plant Industry Bulletin 257, 35 pp., 10 figs., 1912.

GOOD POINTS ABOUT WEEDS.

Weeds are not always useless. Sometimes they are the principal means by which organic matter is restored to the soil, and, generally speaking, a soil is productive in proportion to the quantity of organic matter it contains. In many parts of this country it is customary to farm land until the crops are too poor to be profitable and then "turn it out to rest," as shown in figure 1. This merely means that weeds are permitted to grow on it for several years; after that, the soil will be more productive.

Weeds are also useful at times in preventing soil erosion, especially during the winter months. Weeds are further useful in collecting and holding the nitrates and other soluble salts during periods when crops

FIG. 1.—A field of poor land in Virginia "turned out to rest." Weeds improve the fertility of the soil by adding organic matter.

are not being grown, thus preventing these valuable nutrients from being washed out of the soil. Ordinarily, however, all these benefits may be realized through proper rotations, in which case it is a serious mistake to let weeds grow.

DAMAGE DUE TO WEEDS.

The full reason why weeds reduce yields is not definitely known. It is well recognized that weeds deprive crops of moisture, plant food, and sunlight, and by these means cause decreased yields. Experiments have shown, however, that even where there is a supply of moisture and plant food sufficient for the needs of both the weeds and the crop, weeds still exert a detrimental effect. This may be due in part to the weed roots giving off substances which are poisonous to

crops. The fact that weeds do harm in more ways than has been supposed is all the more reason why the farmer should make strenuous efforts to subdue these invaders. Land that should produce 60 bushels of corn may yield no more than 20 bushels if weeds are not kept down by adequate cultivation, and the net profit to the farmer is relatively much less for the resulting poor crop than these figures on yield show. Figure 2 illustrates a rather common sight of many weeds and poor crops.

Another loss results from the presence of weed seeds in crop seeds. This necessitates much labor in separating or results in dockage by dealers if the separation is not made. Wheat containing wild-onion bulblets is sometimes docked as much as 50 per cent, and in some cases there is no sale at all for such wheat. The agricultural

FIG. 2.—A cornfield with a small crop, due partly to the presence of many weeds.

experiment station of Minnesota estimates that in that State alone the damage to wheat due to weed seeds amounts to two and a half million dollars yearly.

There are other causes of damage resulting from weeds, which in some cases are important. The harvesting and curing of crops are sometimes made difficult by the presence of weeds. Russian thistle, bindweed, and Canada thistle usually are a source of great annoyance at harvest time to the growers of small grains. Again, some weeds harbor fungous and insect troubles which attack near-by crops; the clubroot of cabbage is fostered on the wild-mustard tribe of weeds, and the Colorado potato beetle lives also on nightshade and henbane. Furthermore, some weeds are poisonous or otherwise injurious to man, live stock, or live-stock products. Poison ivy, sumac, jimson

weed, and the seeds of corn cockle are poisonous to man; wild onion and bitterweed spoil dairy products; cowbane, water parsnip, and loco weed are poisonous to stock; and the barbed seeds of squirrel-tail grass and porcupine grass penetrate the noses and mouths of live stock, causing painful sores.

It is difficult to estimate the damage of weeds, but it is probable that they cost the American farmer several hundred million dollars every year.

CLASSIFICATION OF WEEDS ACCORDING TO LENGTH OF LIFE.

In fighting weeds it is extremely important to know how long they naturally live and their habits of reproduction. Weeds are divided into three classes according to their duration or length of life: (1) Annuals, (2) biennials, (3) perennials.

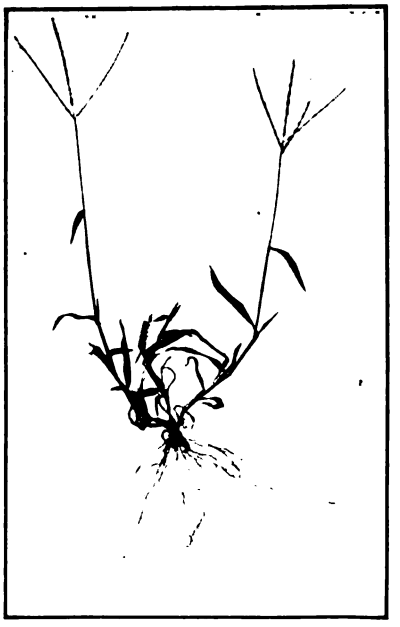

FIG. 3.—A plant of crab-grass, an annual weed.

Annual weeds live only one year, maturing their seeds and then dying. Ragweed, smartweed, and crab-grass are examples of annual weeds. Figure 3 shows an entire plant of crab-grass. Some annuals germinate in the fall, live through the winter, and mature their seeds in the spring. These are called winter annuals. Examples of winter annuals are shepherd's-purse, peppergrass, and fleabane.

Biennial weeds live two years. During the first year they grow rather slowly, producing usually a taproot and a rosette of leaves close to the ground, but the second year they send up flower stems that produce seed, and then die. Examples of biennial weeds are blueweed, bull thistle, and wild carrot. Figure 4 shows an entire plant of blueweed.

Perennial weeds produce each year underground parts which live over to the next year and produce top growth. These underground parts may be of various kinds. They may consist of long, more or less horizontal roots, as in the case of the bull nettle, milkweed, and Canada thistle, or the underground parts may consist of rootstocks or underground stems, as in the case of quack-grass, Johnson grass, and perennial sow thistle. Figure 5 illustrates the characteristic growth of the Canada thistle, while figure 6 illustrates the growth of

Johnson grass. Again, the underground parts may consist of bulbs that split up, as in the case of wild onion, shown in figure 7; or they may be more or less in the form of a taproot, as with dandelion (fig. 8).

THE CONTROL OF WEEDS.

Far more important than to kill weeds is to avoid having weeds to kill. In other words, the farmer should aim to prevent rather than cure the evil. A farm can be made almost free of weeds by strictly observing the following principles: (1) Prevent weeds from going to seed on the farm; (2) prevent weed seeds being brought to the farm; and (3) in the case of perennial weeds, prevent them from making top growth and thus finally starve out the underground parts.

FIG. 4.—A plant of blueweed, a biennial.

The application of the three preventive methods outlined here is fully discussed in the following pages.

HOW TO CONTROL ANNUAL AND BIENNIAL WEEDS.

The annuals and biennials propagate themselves by seeds alone. In dealing with them it is necessary to observe only the first two of the above principles.

HOW TO CONTROL PERENNIAL WEEDS.

Most perennials propagate themselves by their underground parts as well as by their seeds; hence, even if prevented from going to seed they still keep on growing. In dealing with them, therefore, it is necessary to observe all three of the above principles.

PREVENTING WEEDS FROM GOING TO SEED ON THE FARM.

Most persons do not realize what an enormous number of seeds are produced by weeds. The number varies with different species, most kinds producing from one hundred to several thousand seeds per plant. Some weeds, such as wild carrot, burdock, and sow thistle, are capable of producing 20,000 or more seeds to the plant. Moreover, not all weed seeds germinate at once, but delay sprouting for a period, some of them for several years. This is the basis of the old saying, "One year's seeding makes seven years' weeding."

If it is not practicable for the farmer to dispose of his weeds when they are small he should make every effort to prevent them from going to seed. If weeds are attacked when the most advanced have just reached the full-blossom stage, they can be prevented from seeding. At this stage, too, the roots are at their weakest, especially those of the annuals and biennials, which are largely exhausted. No time should be lost, however, in disposing of weeds when the full-blossoming stage has been reached, as seeds will shortly be formed. Some weeds, such as pigweed, produce blossoms that are very inconspicuous, so that unless closely watched they will go to seed before one is aware of it.

Tillage to control weeds.—While tillage in its relation to weeds usually is practiced for the benefit of the immediate crop, it also may serve the purpose of preventing hosts of weeds from maturing

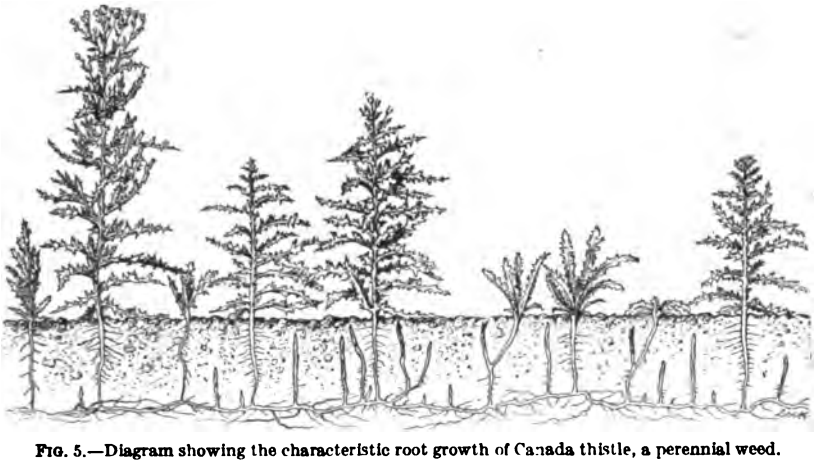

FIG. 5.—Diagram showing the characteristic root growth of Canada thistle, a perennial weed.

seeds. Thorough tillage serves the additional purpose of encouraging the rapid germination of weed seeds in the soil while killing the weed seedlings when young. In no way is the old adage "A stitch in time saves nine" better illustrated than in killing weeds by tillage soon after they have germinated rather than delaying the work until they have attained some size.

The thorough preparation of the seed bed for every crop is an important part in the control of weeds. After plowing, nearly all farmers use a disk or a spring-tooth or spike-tooth harrow to reduce the soil to a good seed-bed condition. Each of these harrowings destroys hosts of young weed seedlings. As it is only the weed seeds within a few inches of the surface of the soil that germinate and as the harrowings encourage the rapid germination of the weed seeds, thorough harrowing at this period may be relied upon to kill a large portion of the weeds that will appear during the season. In fact, it

sometimes happens that the seed bed has been so well prepared that after planting a cultivated crop, such as corn, cotton, or potatoes, but little cultivation is required.

After planting the cultivated crop the same object, that of attacking the weeds when young, should be kept in mind. To this end a drag harrow or a spike-tooth harrow is frequently used, both before and after the crop comes up. More weeds will be killed by one dragging at this time than by several cultivations when the plants have become larger. The farmer shown in figure 9 is going over his land with a drag harrow after planting potatoes. The weeder is also a valuable implement for use at this stage. By removing some of the teeth of this tool it can be used in corn until the crop is nearly waist high. Indeed, some excellent crops of corn have been grown by the use of the weeder only. Some soils are too stony or otherwise not suited to the use of this implement, but where it can be used the weeder is one of the most valuable tools on the farm. The drag harrow and weeder may also be used to advantage with potatoes, cotton, and other cultivated crops. After the crops have become so large that these implements can no longer be used, the tillage is performed with cultivators. Cultivators that destroy weeds most effectively should be used. The best tools for this purpose vary with the kind of crop and the type and condition of the soil, so that it is difficult to lay down exact rules as to the choice of cultivators. Intercultural tillage is especially effective in controlling weeds if the crop has been planted in checkrows so as to permit the implement to work in two directions, as shown in figure 10.

FIG. 6.—Johnson grass, a perennial weed, showing its rootstocks.

If the work of preparation and aftertillage has been thorough, few weeds will come up and go to seed after cultivation stops. This is especially true where a winter cover crop, such as wheat, crimson

clover, or vetch, follows the cultivated crop. Figure 11 shows wheat seeding in Virginia after the corn has been cut and shocked.

Cultivated crops, therefore, offer abundant opportunity to rid a farm of weeds. If properly handled, they are rightly termed "cleaning crops." On the other hand, where these crops are not well cultivated, weeds are actually stimulated to vigorous growth and prolific seeding. Such crops are consequently a boon or a menace, depending upon how they are handled.

Besides the usual cultivated crops, small-grain crops can also sometimes be cultivated to advantage in the spring with a spike-tooth harrow or weeder. This does not permanently injure the young crop, and it kills hosts of small weed seedlings which would otherwise make trouble. Farmers in the upper Columbia River basin are able to control wild mustard by repeatedly harrowing fall-sown wheat in the spring; without this harrowing the mustard would be very troublesome.

FIG. 7.—Wild onion, or garlic, a perennial weed, showing the bulbs.

After the small-grain crop is harvested it is often good practice in the Northern States to harrow or disk the stubble to encourage the germination of the weed seeds that are at or near the soil surface. The seedlings are killed by the fall plowing or by cold weather. Some weeds, such as ragweed and foxtail, start to mature seeds soon after harvest, so that care must be taken to turn the plants under before the seeds approach maturity. Plowing without the preliminary disking would turn under millions of weed seeds to make trouble in future years.

Mowing to prevent seeding.—Mowing is another way of preventing weeds from going to seed. As a rule, it is best to mow when weeds have reached the full-bloom stage. Many farmers mow their pastures once or twice each year and as a result have gradually driven out the weeds and thickened the grass stand. When there are

patches in grain fields thick with weeds, it will pay to cut them, grain and all, before the weeds start to go to seed. Most careful farmers mow or cut their fence-row and roadside weeds once or twice a year to prevent their seeding. In figure 12 is shown a fence row that has been mowed regularly, while the fence row shown in figure 13 has been made a source of profit through the production of hay instead of weeds. Figure 14 illustrates the possibility of producing beautiful lawns from fence rows.

It pays to cut a hay crop early, in order to prevent weeds from going to seed as well as to secure a better quality of hay. After a grain crop is removed, a crop of weeds, such as ragweed or foxtail,

FIG. 8.—A dandelion plant, a taprooted perennial weed.

usually follows, which, if not disturbed, not only reseeds the land for further crops of weeds, but may do much damage to a young seeding of clover or grass. Mowing these weeds will prevent most of them from going to seed, and, further, the clippings will be of value as a mulch for the young grass.

Hand work to prevent seeding.—Quite often a few scattered weeds will occur in a field. These weeds can be removed by hand with little work, whereas if allowed to mature they would thoroughly seed the land and make trouble for the future. Such weeds may be prevented from seeding either by hand pulling or by digging them

out with a mattock, hoe, or spud so far below the surface that new top growth will not spring up and mature seeds. Annual and biennial weeds will make no further appearance if pulled or cut off when they are in full blossom. The spud (fig. 15) is a tool with a long handle and a narrow chisel-like blade at one end. This is very effective in disposing of weeds with thick roots, such as bull thistle, mullein, and chicory. Many farmers have cleaned their farms of corn cockle, wild mustard, and many other weeds by a few hours of hand work each year when these weeds were in full blossom.

Spraying to prevent seeding.—In case of certain weeds infesting small-grain crops it has been found profitable to spray with a solution

FIG. 9.—A spike-tooth harrow in use after a crop has been planted. This practice kills hosts of weed seedlings.

of copper sulphate, iron sulphate, or salt. If this treatment does not entirely kill the weeds, it at least prevents them from going to seed. Such treatment, if well done, does not permanently injure the grain and is effective against the weeds. This method seems to be of most use against the wild mustard family of plants.

The spray solutions are made by dissolving either 12 pounds of copper sulphate, 100 pounds of iron sulphate, or 125 pounds of common salt in 50 gallons of water. This quantity of solution is sufficient to spray about 1 acre. Any machine that throws a fine mist-like spray may be used. Where areas of considerable size are to be treated, a traction sprayer with a boom 12 to 20 feet long is the most

economical equipment. In the case of wild mustard in small-grain fields the best time to spray is when the most advanced of the mustard plants are just starting to bud.

Sheep pasturing to prevent seeding.—Sheep are of use in preventing weeds from seeding. A pasture on which sheep are running (fig. 16) is usually more nearly free of weeds than where cattle or horses are pasturing. In some parts of the United States sheep are turned into standing corn after cultivation stops (fig. 17), for the purpose of pasturing off the late weeds. Sheep turned on grain stubble tramp

FIG. 10.—Corn growing in checkrows, a practice which permits excellent cultivation. Not a weed can be seen.

weed seeds into the soil, thus causing many of the seeds to germinate at once. The resulting plants are either pastured off or frozen out.

Burning to prevent seeding.—Burning weeds is often useful in killing weed seeds, both in connection with weeds cut green and allowed to dry and with matured weeds. It is sometimes necessary to gather such plants into piles before they will burn, but it is always best to disturb them as little as possible, so that the seeds will not scatter.

PREVENTING WEED SEEDS FROM BEING BROUGHT TO THE FARM.

The second of the three main points in weed control is preventing the introduction of weed seeds on the farm. No matter how careful a man may be in preventing weeds from going to seed on his land, most of his work will be for nothing if he permits seeds to be con-

stantly brought to his farm from the outside. Seeds may be brought to the farm in various ways.

FIG. 11.—A cornfield being prepared for a winter crop. Planting the land in this way kills many weeds.

Introducing weed seeds in crop seeds.—Many of the purchased grain, clover, and grass seeds contain weed seeds as impurities. In figure 18 is shown clean clover seed, while in figure 19 is seen clover seed

FIG. 12.—A fence row which has been mowed regularly, thus preventing weeds from going to seed.

containing various kinds of weed seeds. How can the farmer purchase clean seed? In no permanent way will the quality of seed

offered for sale be greatly improved except by greater knowledge and alertness on the part of the consumer. First, the farmer should know what constitutes good seed; second, he should know fairly closely what high-grade seed is worth; and, third, he should be willing to pay a fair price for it. Laxity on one or more of these points is responsible for most of the farmer's trouble over poor seeds. Seedsmen say that they are forced to carry poor seeds in stock because many farmers will not pay for the better grades. Cheap seeds are really the most expensive kind that can be purchased.

In improving his knowledge of what constitutes good seeds, the farmer will find the advice of the State agricultural experiment stations and the United States Department of Agriculture of great

FIG. 13.—Making hay along a fence row in Illinois, thus preventing weeds from going to seed and also incidentally increasing the farmer's income.

assistance. These institutions gladly test samples of seeds for farmers free of charge. The test will show whether there are any weed seeds or other impurities present and the percentage of germination of the crop seed. Many farmers are now making their own tests and with a little practice any man can learn to do this according to the directions issued by the Department of Agriculture.[1] In either case it is necessary to get the test under way well in advance of the time of seeding. In purchasing seed of alfalfa and clover the most important point to consider is the presence of dodder seed. Clover seed should also be examined for seeds of the plantains.

[1] F. H. Hillman. Testing farm seeds in the home and in the rural school. U. S. Department of Agriculture, Farmers' Bulletin 428, 47 pp., 32 figs., 1911.

Introducing weed seeds in stock feeds.—Some kinds of stock feed are free of weed seeds, while others are not. Cottonseed meal, oil meal, brewers' and distillers' grains, corn bran, middlings, and the gluten feeds are practically free of weed seeds; but molasses feeds, oat chop, wheat bran, and the mixed feeds are apt to contain more or less seeds of various weeds. This is especially true of that class of mixed feeds made from mill by-products, for the reason that such by-products are partly composed of screenings. These screenings contain weed seeds resulting from the cleaning of grain. Some firms grind or heat the screenings that go into mixed feeds, and in such cases the percentage of live weed seeds is very low. A number of States require that the

FIG. 14.—A fence row turned into a lawn; one way of solving the weed problem.

ingredients in stock feed be named in the labels on the bags, and this is desirable in all States. Some States also issue feed-control bulletins, stating the analysis of various feeds offered for sale, including the proportion of viable weed seeds. If the farmer reads these bulletins and the labels on the bags he will be in a position to judge whether or not he is introducing weed seeds on his farm in stock feeds.

Introducing weed seeds in manure.—Nearly all purchased manure is full of weed seeds. If it is hauled to the farm when fresh, many thousands of weed seeds are introduced, so that the farmer is storing up future trouble for himself. As this manure usually has to be removed from the town in the fresh state, the only chance to compost

it in order to make the weed seeds rot is after it reaches the farm. It has been found that the weed seeds in manure piles rot quickly under ordinary conditions, so that practically all of them have lost their vitality in two months. Whether the farmer should compost city manure by leaving it in piles after he has drawn it to his farm is questionable. This would require extra handling, and unless care is exercised the manure will lose some of its value. Still, in many cases it would undoubtedly pay to do this for the sake of keeping the farm free of weeds. The answer to this question depends largely upon the farmer's cropping system.

FIG. 15.—The spud, an effective tool for cutting off weeds with thick roots below the surface of the soil.

Introducing weed seeds with thrashing outfits.—Thrashing outfits are very likely to bring weed seeds to the farm. It is a wise precaution to see that the separator is well cleaned before it reaches the farm, or at least is cleaned in a place where the weed seeds will not be scattered on the fields. Wild mustard is very apt to be introduced by this means. A very progressive farmer in Vermont, who has driven this weed entirely from his place, goes out with a broom to meet the thrashing machine just before it reaches his farm and attends to cleaning it himself.

FIG. 16.—Sheep as weed destroyers. This Vermont pasture, on which sheep are grazing, is practically free of weeds.

Introducing weed seeds in hay and straw.—Purchased hay and straw are almost sure to contain weed seeds, and as long as a man continues to buy them there is little chance for him to have a weed-free farm. The only way to prevent seeds getting to the land where

hay or straw is purchased is to leave the resulting manure in a pile, or, better yet, in a pit, for several months before spreading.

Introduction of weed seeds by the wind.—Lastly, weed seeds may get to a farm by being wind blown. This is especially true of chicory, dandelion, broom sedge, Canada thistle, and such other weeds as possess a light, feathery pappus. Figure 20 shows a lawn full of dandelion plants that are about ripe. Such seeds may be carried a mile or more in a strong wind. The Russian thistle of the Western States is perhaps the greatest wind-blown weed pest. The matured plant, which is almost round in shape, rolls across the prairie, scattering seed as it goes. A good fence is very effective in arresting the progress of this enemy.

The individual farmer is almost helpless against the introduction of most weed seeds by means of the wind, and the situation requires

FIG. 17.—Sheep in Kansas pasturing off weeds in standing corn after cultivation stops.

community action. Most of our States have weed laws which were enacted to prevent certain weeds from going to seed, but these laws are not rigidly enforced. Some day a more enlightened public opinion will require the enforcement of the weed statutes. The individual farmer, however, can greatly lessen the evil effects of wind-blown weeds by keeping a continual lookout on the boundaries of his farm, especially on the side of the prevailing winds, and by destroying the weeds as they appear. A certain good farmer in Virginia, who has his place largely in pasture, has a shiftless neighbor whose farm is full of broom sedge, the weed illustrated in figure 21. The shiftless man is on his west side, so that the seeds blow over to his land every year in large numbers. Many broom-sedge plants start growing in his grass land, but by chopping out the plants where they are rather

scattered and by plowing up the field and running it through a rotation where the broom sedge has become thick, he manages to prevent the weeds from spreading to the remainder of his farm.

PREVENTING THE TOP GROWTH OF PERENNIALS.

The last of the three weed preventives is keeping down the top growth of perennials, in order to starve out the underground parts. This top growth is equivalent to the lungs of animals; without it they can not live. Any methods that successfully keep down the top growth and at the same time suit the farmer's convenience may be used. Among the ways that may be adopted for keeping down

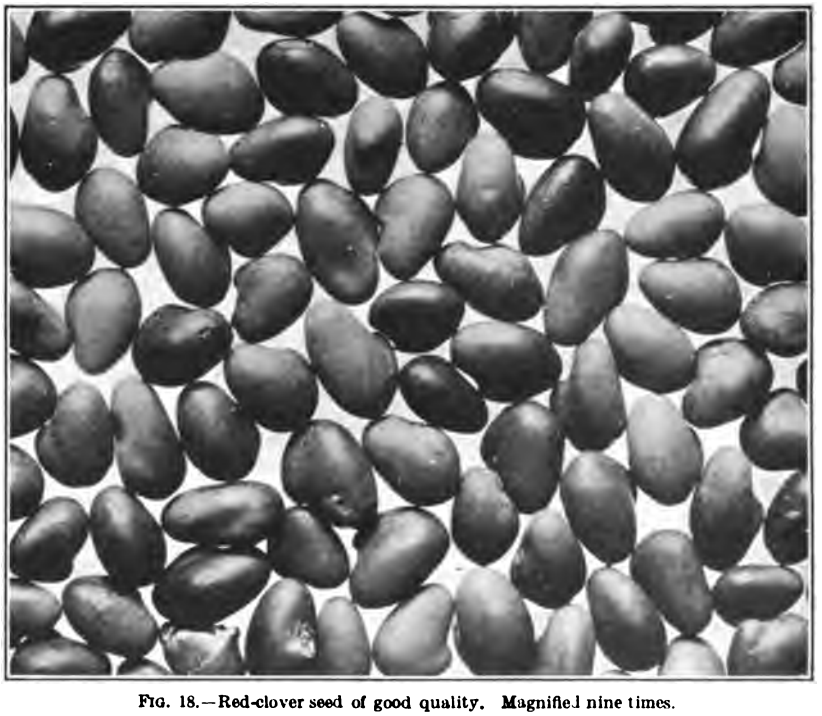

FIG. 18.—Red-clover seed of good quality. Magnified nine times.

top growth are the following: (1) Clean cultivation; (2) pasturing; (3) growing smother crops; (4) frequent cutting with a hand hoe, spud, or mower; and (5) smothering small patches with building paper or other material.

Clean cultivation.—In most cases cultivation will have to be relied upon to destroy perennials. The work may be done either with or without a cultivated crop growing on the land. Many farmers have eradicated perennial weeds by giving thorough cultivation to a crop. Cultivation is especially effective if the crop has been planted in checkrows, so as to permit working in two directions, as shown in figure 10. The ordinary shovel and tooth cultivators permit many

weed stems to slip through unharmed. It is often best, therefore, to use cultivators of the sweep or weed-knife type. These sweeps skim along under the surface of the soil and cut off all weed stems. On many of the modern cultivators, sweeps 9 to 18 inches wide may be attached in place of the shovels. Figure 22 shows a number of implements of the sweep type.

No matter how thoroughly the tops have been kept down during the period of cultivation, most well-established perennials will continue to send up tops after cultivation stops. This situation may be met by frequent choppings with a hoe. Hand hoeing in such cases is not as tedious as it may seem, since most perennials do not

FIG. 19.—Red-clover seed of low grade, containing many weed seeds. Magnified nine times.

occupy the land solidly, but occur in patches. If the top growth is thus thoroughly kept down, one year is usually sufficient to eradicate even the worst of our perennials. This plan is especially effective against Canada thistle, bull nettle, and bindweed, or wild morning-glory.

Perennials may often be attacked most effectively by clean cultivation without growing a cultivated crop; in other words, by a bare fallow. It is seldom advisable to fallow for an entire year, since this does not permit the farmer to get any use of his land. A better plan is to use the land during the early part of the season and to fallow it the latter part. For instance, the land may be past-

until midsummer, or a crop of hay or small grain may be taken off before starting the fallow. This plan has the additional advantage of starting the work of eradication by fallowing at a period when nearly all weeds are in their most susceptible stage. Under this plan the work of fallowing should be started as soon after harvest as possible; the land should be plowed and then harrowed or disked at frequent intervals during the remainder of the season to prevent top growth. Ordinarily, shallow plowing is best in fallowing for weed control, as this keeps the mass of weed roots at or near the surface, where they will be more easily dried out by the sun. If this fallowing be well done, many kinds of perennials will have died by the

FIG. 20.—A lawn full of ripe dandelion; an example of the harm done by wind-blown seeds.

close of the season, but it is usually advisable to plant a cultivated crop the next spring in order to destroy such plants as may persist. Under this plan the greater part of the work of eradication is done expeditiously by large implements and without the hindrance of cultivated crops; furthermore, it is done at a time of year when the farmer is ordinarily not pressed with other work. This method is quite successful against the weedy grasses, such as Johnson grass, Bermuda grass, and quack-grass.

Pasturing.—Pasturing may often be found of much help in keeping down the top growth of perennials. Sheep are of first importance in this connection. They will browse upon almost all kinds of weedy growths and fatten under the process. In parts of the West,

when the pasture grasses become brown during the summer, sheep will turn their attention to the weeds, which are the only green feed in sight. This fact has been taken advantage of in killing bindweed and the small-leaved milkweed. Goats are even more omnivorous than sheep, but the regions where it is profitable to keep goats are limited. Hogs are of some value in weed eradication, because they will root for the underground parts of many weeds. These animals have been used to great advantage in getting rid of bindweed, or wild morning-glory.

Where it is feasible to confine sheep, goats, or hogs to very restricted areas for one or more seasons, they will in most cases completely kill perennial weeds. Where it is not practicable to graze sufficiently close to entirely destroy perennials the grazing still greatly weakens

FIG. 21.—A field of broom sedge and scrub pine. The seeds of broom sedge are carried long distances by the wind, infesting other lands.

the root system of these plants, making it an easy task to complete the destruction by cultivation.

Smother crops.—Thick stands and vigorous growths of smother crops may be depended on to keep down the top growth of perennials. The most commonly used smother crops are alfalfa, buckwheat, soy beans, millet, sorghum, and bur clover. Some weeds are more susceptible to this treatment than others. Nut-grass may be eradicated by a continuous succession of smother crops, including soy beans or cowpeas in the summer and bur clover or winter grains for a winter crop. Alfalfa, where it succeeds well, is the most effective smother crop, largely because it combines frequent clipping with the smothering effect. It may be relied upon to reduce greatly or even to eradicate entirely most perennials except some of the grassy weeds. In the case of smother crops, as with pasturing, the principal

value is to weaken the root systems of perennials, which facilitates the work of cultivation which is to follow.

Mowing or cutting.—Cutting off repeatedly the tops of perennial weeds with a mower, scythe, or other tool may sometimes be used to advantage. This is of most use on pastures, roadsides, and other uncultivated places. It has been found that mowing twice a year for two years will eradicate the fern brake, one of the bad weeds of pastures in New England and New York.

Smothering with building paper and other materials.—Where perennial weeds occupy very limited areas it is often practicable to prevent further spread by covering the infested area with building paper, taking care to lap over and weight down the ends so as to exclude all

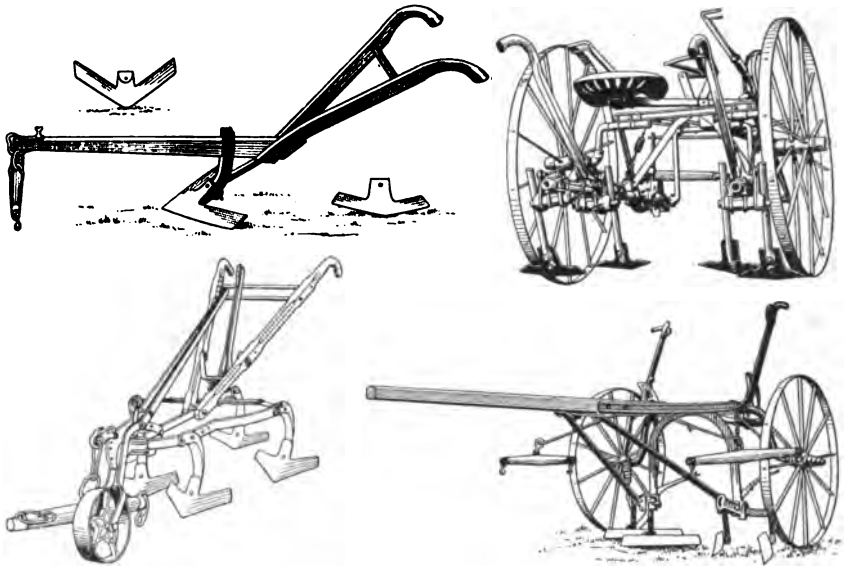

FIG. 22.—Various types of cultivators equipped with knives or sweeps that are effective in cutting off the stems of perennial weeds below the soil surface.

sunlight. Building paper suitable for this use may be obtained at from $2.25 to $4 per thousand square feet, or $97 to $172 per acre, depending on its thickness. Manure, straw, and other materials are also employed for this purpose.

CONCLUSION.

The problem of suppressing weeds is a many-sided one and an important part of the management of the farm. Successful crop management includes successful weed management.

Larger crops mean fewer weeds.—Generally speaking, the larger the crops, the fewer the weeds present. This is especially true with small grain and hay, since good stands of these crops will tend to

smother out weeds. Figure 23 shows a weedy meadow which produced only one-half ton of hay per acre, while the meadow in figure 24, which was free of weeds, produced 3 tons per acre. Furthermore,

FIG. 23.—A very weedy meadow; yield about one-half ton per acre.

pastures that are given good care by top-dressings and by not overgrazing always contain fewer weeds and more grass than those poorly managed. Figure 25 shows an overgrazed pasture in the State of

FIG. 24.—A meadow free of weeds; yield about 3 tons per acre.

New York, where the sweet fern has worked in badly, as indicated by the dark patches, while figure 26 shows a well-managed pasture in Virginia that is almost free of weeds.

Special methods of handling certain weeds.—The farmer should know the kind of weeds which he has to fight, because in the case of some of them special methods have been discovered which greatly reduce the amount of work necessary. The United States Department of Agriculture has issued bulletins treating individually a number of the worst weeds and these publications may be obtained on request.[1]

Rotations and weeds.—An important benefit from practicing a rotation is in the control of weeds. If land is planted to the same crop year after year, certain weeds have ample opportunity to make top growth and mature their seeds, and these weeds therefore become firmly established; but if the land is planted to different crops in

FIG. 25.—A poorly managed, weedy pasture in New York. The dark patches are sweet fern.

succession these weeds do not have the opportunity to make nearly as much headway.

Furthermore, adopting a rotation usually means the growing of grass, clover, or other forage crops. These crops not only discourage many kinds of weeds by their shading effect, but also give weeds a poor chance to mature seeds, as they are cut for hay before most weeds ripen.

[1] The following Farmers' Bulletins on weeds may be obtained free of charge on application to the Secretary of Agriculture: No. 279, A Method of Eradicating Johnson Grass; 368, The Eradication of Bindweed, or Wild Morning-Glory; 464, The Eradication of Quack-Grass; 545, Controlling Canada Thistles; and 610, Wild Onion: Methods of Eradication.

The following mimeographed circulars may also be obtained by addressing the Office of Farm Management of the United States Department of Agriculture: Orange Hawkweed, Skeleton Weed, Spraying for Wild Mustard, Nut-Grass, Chickweed in Lawns, Dandelions in Lawns, Crab-Grass in Lawns, and Killing Vegetation with Plant Poisons.

Again, adopting a rotation often means growing cultivated crops on land where such crops have not been raised. The value of cultivated crops in cleaning lands of weeds has already been emphasized.

Demonstrations of the value of a rotation in controlling weeds are available in many localities. For example, in western Kansas wheat is usually grown continuously and when this is the case weeds are very troublesome; but when a rotation, including a cultivated crop and a forage crop, is adopted, the weeds that are so common under continuous wheat growing do not have so much chance to make growth and to mature their seeds. Hence, weeds become very much reduced. Another example is furnished in parts of eastern New York, where it is customary to keep land in meadow for many years.

FIG. 26.—A well-managed, weed-free pasture in Virginia.

These meadows become foul with orange hawkweed, oxeye daisy, wild carrot, and other weeds. (Fig. 27.) Introducing a cultivated crop and a grain crop soon disposes of most of these weeds.

SUMMARY.

It is possible for a farmer, especially if he follows a good rotation, to make his farm almost weed free. This may be done by observing three main principles of weed control: (1) Preventing weeds from going to seed on the farm; (2) preventing the introduction of weed seeds on the farm; and (3) preventing perennial weeds from making top growth. These principles are of far greater importance than the particular methods by which they are worked out.

Equally as important as the principles is the man behind them. Many men make a start to clear their farms of weeds, but quit too soon. Often the campaign is stopped when success is in sight, and the weeds soon recover. Clearing a farm of weeds, especially perennials, is no easy task; it requires more than average intelligence and

FIG. 27.—A New York meadow which consists largely of oxeye daisy.

perseverance. If, however, one outlines a plan of attack based on the above principles of weed control and faithfully sees this plan through to a finish, he can practically rid his farm of weeds without a great amount of labor and expense.

APPENDIX.

FIFTY WORST WEEDS.

Table I gives an alphabetical list of the 50 worst weeds of the United States, with such information as will enable the reader (1) to identify them, (2) to determine the nature and place of their greatest injuriousness, and (3) to determine their duration or natural length of life; that is, whether annual, biennial, or perennial. With this knowledge one will be able to attack much more intelligently any troublesome weed.

TABLE I.—*Descriptive list of the fifty worst weeds of the United States.*

[A = annual, B = biennial, P = perennial.]

Common name, botanical name, and duration of life.	Color, size, and arrangement of flowers.	Sections where injurious.	Method of seed distribution; vegetative propagation of the perennials.	Place of growth and products injured.
Bermuda grass, wire-grass (*Capriola dactylon*), P.	Purple; $\frac{1}{4}$ inch; spikes.	Maryland to Missouri and southward.	Seeds sparingly; rootstocks.	Fields and lawns; hoed crops.
Bindweed, field bindweed (*Convolvulus arvensis*), P.	White or pink; 1 inch; solitary.	Entire United States, especially California.	Grain and flax seeds; creeping roots.	Rich moist soils; grain and hoed crops.
Bindweed, wild morning-glory (*Convolvulus sepium*), P.	White or rose; 2 inches; solitary.	Mississippi Valley region.	Grain and flax seeds; rootstocks.	Rich prairie and river bottoms; corn and small grain.
Bitterweed, fennel, yellow dog fennel (*Helenium tenuifolium*), A.	Yellow; $\frac{1}{2}$ inch; head.	Virginia to Kansas and southward.	Wind, hay, animals.	Meadows and pastures; injures live stock and taints milk.
Broom sedge (*Andropogon virginicus*), P.	Green; $\frac{1}{4}$ inch; racemes.	Massachusetts to Michigan, Florida, and Texas.	Wind; short rootstocks; plants in tufts.	Fields and waste lands; pastures and meadows.
Buffalo bur, sand bur (*Solanum rostratum*), A.	Yellow; $\frac{1}{2}$ inch; solitary.	Illinois and Colorado to Texas.	Plants rolled by wind; seeds in hay and by animals.	Fields; grain and hoed crops, wool.
Bull nettle, horse nettle (*Solanum carolinense*), P.	Purple; 1 inch; solitary.	Entire United States.	Plants rolled by wind; running roots.	Everywhere; grain and hoed crops, pastures.
Bur-grass, sand bur (*Cenchrus carolinianus*), A.	Green; $\frac{1}{2}$ inch; bur.	Maine to Florida and westward to Colorado.	Animals, especially sheep.	Sandy land pastures and waste places; pastures and wool.
Chess, cheat (*Bromus secalinus*), A.	Green; spikelets in panicles.	All grain sections.	Grain seed, especially wheat.	Everywhere; grain fields.
Chickweed, common chickweed (*Alsine media*), A.	White; $\frac{1}{4}$ inch; cymes.	Entire United States.	Grass and clover seed, animals; has a long seeding period.	Meadows, lawns; winter crops.
Cocklebur, clotbur (*Xanthium americanum*), A.	Green; $\frac{1}{4}$ inch; head.	.....do.....	Carried by animals.	Cultivated fields and waste places; hoed crops and wool.
Crab-grass (*Syntherisma sanguinale*), A.	Green; spikes.....	Entire United States, especially the South.	Clover and grass seed, hay, animals.	Cultivated fields, gardens, lawns; hoed crops.

TABLE I.—*Descriptive list of the fifty worst weeds of the United States*—Continued.

Common name, botanical name, and duration of life.	Color, size, and arrangement of flowers.	Sections where injurious.	Method of seed distribution; vegetative propagation of the perennials.	Place of growth and products injured.
Daisy, oxeye daisy (*Chrysanthemum leucanthemum*), P.	White with yellow center; 1 inch; heads.	Maine to Virginia and Kentucky.	Clover seed, hay; woody, rather short rootstocks, but largely by seed.	Pastures, meadows, roadsides; hay, pasturage.
Dandelion (*Taraxacum officinale*), P.	Yellow; 1½ inch; head.	Entire United States.	Wind; taproot, which spreads but little.	Lawns, meadows, waste places; hay and lawns.
Dock, yellow dock, sour dock (*Rumex crispus*), P.	Green; ¼ inch; panicle.	.....do.....	Hay and straw, clover and grass seed; taproot, which spreads but little.	Hay, small grain, and hoed crops.
Dodder, alfalfa dodder, field dodder (*Cuscuta arvensis*), A.	Yellow; ⅛ inch; clusters.	All clover and alfalfa regions.	Hay, clover, and alfalfa seed.	Clover and alfalfa fields.
Dogbane, Indian hemp (*Apocynum cannabium*), P.	Greenish white; ¼ inch; terminal clusters.	Upper Mississippi Valley.	Wind; creeping root.	Fields with sandy soil; pasture, grain and hoed crops.
Fern, brake (*Pteridium aquilinum*), P.	No flowers.....	Northwestern States and the Pacific coast.	Spores scattered by wind; running roots.	Logged-off land, meadows, and pastures.
Fleabane, horseweed (*Erigeron canadensis*), A.	White; ⅛ inch; heads in cymes.	Entire United States.	Hay, grass and clover seeds.	Meadows, pastures, and grain fields.
Foxtail, yellow foxtail, pigeon grass (*Chaetochloa glauca*), A.	Green; spikes.....	.....do.....	Animals, hay, grain, and grass seeds.	Land cultivated in early part of season; young grass and clover seedlings.
Hawkweed, orange hawkweed, devil's-paintbrush (*Hieracium aurantiacum*), P.	Orange; 1 inch; heads.	Maine to Ohio.	Wind, grass and clover seeds; runners similar to strawberry.	Untillable pastures and meadows.
Iron weed (*Vernonia noveboracensis*), P.	Purple; ½ inch; heads.	Maine to Maryland and Iowa to Kansas.	Wind; short thick rootstocks, making plant grow in bunches.	Pastures and meadows.
Jimson weed (*Datura stramonium*), A.	Purple; 3 inches; solitary.	Maine to Minnesota and Texas.	Pods and plants blown by wind.	Pastures, barnyards, and waste lands; seeds, flowers, and leaves poisonous.
Johnson grass (*Holcus halepensis*), P.	Green; ½ inch; panicle.	Virginia to Texas and California.	In hay, grain, and grass seed; running rootstocks.	All crops except hay.
Lamb's-quarters, pigweed (*Chenopodium album*), A.	Green; very small; panicle.	Entire United States.	Grain and grass seed.	Grain fields and hoed crops.
Lettuce, prickly lettuce (*Lactuca virosa*), A.	Yellow; ¼ inch; heads in panicles.	Ohio to Iowa, Utah to California.	Wind.....	Everywhere; all crops.
Milkweed, common milkweed (*Asclepias syriaca*), P.	Purple; ¼ inch; umbels.	New York to Minnesota.	Wind; creeping roots.	All crops and in pastures.
Morning-glory (*Ipomea hederacea*), A.	White, purple, or blue; 1½ inch; solitary.	New York to Missouri.	Corn stover, straw, and wind.	Cultivated fields, especially corn, and small grain.
Mustard, wild mustard, charlock (*Brassica arvensis*), A.	Yellow; ¼ inch; racemes.	Maine to Washington.	Grain, grass, clover, and rape seeds.	Small-grain fields and meadows; grains.
Nut-grass, coco (*Cyperus rotundus*), P.	Brown; $\frac{1}{16}$ inch; spikelets.	Maryland to Florida and Texas.	Wind, nursery stock, hay, and grass seed; tubers.	All soils; hoed crops.
Penny cress, Frenchweed (*Thlapsi arvense*), A.	White; ⅛ inch; racemes.	North Dakota and Minnesota.	Wind.....	Grain fields and pastures; grain and dairy products.
Pigweed, redroot, careless weed (*Amaranthus retroflexus*), A.	Green; quite small; spikes in panicles.	Entire United States.	In grain and grass seeds; plants blown by wind.	Plowed land; hoed crops.
Plantain, buckhorn, ribgrass (*Plantago lanceolata*), P.	White; $\frac{1}{16}$ inch; spike.	.....do.....	Hay, clover and grass seed; spreads but slowly from a crown.	Everywhere; meadows, pastures, and lawns.

TABLE I.—*Descriptive list of the fifty worst weeds of the United States*—Continued.

Common name, botanical name, and duration of life.	Color, size, and arrangement of flowers.	Sections where injurious.	Method of seed distribution; vegetative propagation of the perennials.	Place of growth and products injured.
Poison ivy, poison oak (*Rhus toxicodendron*), P.	Greenish white; ⅛ inch; panicles.	Entire United States.	Does not spread fast by seeds; running rootstocks.	Moist rich land, along fences; poisonous by contact.
Purslane, pusley (*Portulaca oleracea*), A.	Yellow; ¼ inch; solitary.	.....do.....	Tillage implements; has a long seeding period.	Rich cultivated land, especially gardens; hoed crops.
Quack-grass, witch-grass (*Agropyron repens*), P.	Green; spike.....	Maine to Pennsylvania and Minnesota.	Seeds of grain and coarse grasses; creeping rootstocks.	All crops on the better soils; hoed crops.
Ragweed, smaller ragweed (*Ambrosia elatior*), A.	Yellow; ⅛ inch; small heads on spikes.	Entire United States.	Wind carrying matured plants; in grain and red-clover seeds.	Everywhere, especially grain stubble; hoed crops and young grass seeding.
Russian thistle, tumble weed (*Salsola pestifer*), A.	Purplish; ¼ inch; solitary.	Minnesota to Washington and southward.	Wind rolling matured plants.	Everywhere; small-grain and hoed crops.
St. John's-wort (*Hypericum perforatum*), P.	Yellow; ¾ inch; cymes.	Maine to North Carolina and Iowa.	In hay and grass seed; rootstocks.	Meadows, pastures, and waste places.
Smartweed (*Polygonum pennsylvanicum*), A.	Light rose; $\frac{1}{16}$ inch; racemes.	Maine to Minnesota, Florida, and Texas.	Wind carrying matured plants.	Moist, rich soils; hoed crops and young grass seedings.
Smartweed, marsh smartweed, devil's shoestring (*Polygonum muhlenbergii*), A.	Rose color; $\frac{1}{16}$ inch; spikes.	Indiana to Iowa.	Wind and farm machinery; rootstocks.	Wet land, prairie, and muck soils; hoed crops, hay, pasture.
Sorrel, sheep sorrel, horse sorrel (*Rumex acetosella*), P.	Red; ⅛ inch; panicles.	Entire United States.	In clover seed; creeping roots.	Meadows and pastures.
Sow thistle, perennial sow thistle, field sow thistle (*Sonchus arvensis*). P.	Yellow; ¾ inch; heads.	Maine to Minnesota.	Wind; running rootstocks.	Grain fields and hoed crops.
Squirreltail grass, squirrel grass, foxtail, wild barley (*Hordeum jubatum*), A.	Green; spike with long bristly glumes.	Minnesota to Texas and California.	Hay, animals, wind	Meadows and pastures; barbed seeds produce sores on livestock.
Thistle, Canada thistle (*Cirsium arvense*), P.	Purple; ¾ inch; heads.	Maine to Pennsylvania and Washington.	Wind, in hay and straw and in clover and grass seed; creeping roots.	All crops.
Thistle, common thistle, bull thistle (*Cirsium lanceolatum*), B.	Reddish purple; 1 inch; heads.	Maine to Virginia and Washington.	Wind, in alfalfa, clover, and grass seeds.	Pastures, meadows, and winter wheat.
Wild carrot (*Daucus carota*), B.	White; very small; umbels.	Maine and Virginia to the Mississippi.	In foreign clover and alfalfa seed; carried by animals and wind.	Meadows and pastures.
Wild oats (*Avena fatua*), A..	Green; panicles; similar to oats.	Wisconsin to Washington.	In seed oats.....	Oat fields; awns injurious to stock.
Wild onion, garlic (*Allium vineale*), P.	Flowers rare; umbels with bulblets.	Rhode Island to Georgia and west to Missouri.	Seeds rare; bulblets carried in wheat; underground bulbs.	Everywhere; wheat and dairy products.
Winter cress, yellow rocket (*Barbarea vulgaris*), P.	Yellow; ⅛ inch; racemes.	Maine to Virginia and westward.	In grain, clover, and grass seeds.	Grain fields, pastures, and meadows.

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FARMERS' BULLETIN

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Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.

A METHOD OF ANALYZING THE FARM BUSINESS.

By E. H. THOMSON, *Agriculturist*, and H. M. DIXON, *Scientific Assistant*, *Office of Farm Management*.

INTRODUCTION.

This bulletin furnishes outlines of a method for analyzing the farm business to determine the investment, receipts, expenses, and labor income. Its purpose is to help the farmer understand the financial side of his business. Farmers have sometimes been unjustly criticized for knowing little about the business side of their work. The fact is that they usually have the details sufficiently in mind, but they are not always able to summarize and bring them together into a concrete statement.

In the work of the Office of Farm Management several thousand farms have been studied by this method, the object being to analyze their operations from a business standpoint and thereby learn some of the most important reasons for their success or failure. Experience shows that it is not possible to distinguish profitable farms by casual observation. Where a farmer is operating a large business, even a low rate of interest without any wages for himself would bring in sufficient funds to give a prosperous appearance to the farm. But a farm can not properly be called successful unless it pays a fair rate of interest on the investment, returns fair wages for the farmer's labor, and maintains at the same time the fertility of the soil. A better realization of the fact that the farm is a complex business subject to certain economic laws is one of the greatest benefits to be derived from such a study as is outlined in this bulletin.

Farmers already know that the gain from a big business should be more than from a small one, that good cows are more profitable than

NOTE.—In this bulletin a method is outlined for an analysis of the farm business to determine the investment, receipts, expenses, and labor income involved.

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poor ones, and that good crops are more desirable than those which do not pay for harvesting. The real difficulty is that the farmer has had no convenient way of measuring just how good or how poor his business really was, i. e., he has had no way of measuring its efficiency. With the facts that are made available by such an analysis as is here provided, he can more readily find the strong and the weak points in his system of management and thus make improvements with some confidence in the results.

The method of farm analysis given in this bulletin is that which has been used in the Office of Farm Management for a number of years in the study of the business of farming. Many of the items to be recorded may appear to be rough estimates, but those who undertake studies of this kind on a large scale will be surprised to find how intimately most farmers know the details of their business when it is analyzed into the elements that correspond to the terms in which the farmer thinks when studying his business. A farmer may not know offhand what his total farm income is, but he does know with considerable accuracy the facts necessary to determine this income. It is important also to remember that the final result of the analysis of a farm business is determined mainly by a few large items which the farmer does know quite accurately. Variations in the numerous small items are as likely to be above as below the correct values and hence tend to balance each other. A variation of a few dollars in the final result is not a matter of great importance and would not seriously affect the conclusions to be drawn as to the profitableness or unprofitableness of the farm business.

The blanks used in this form of analysis will not only be useful to farmers in analyzing their own business, but will be especially helpful to teachers in agricultural high schools, as well as to county agents and other extension workers. Teachers can furnish their students with copies and have each obtain a record of his own home farm. These records can then be summarized and thus furnish valuable information, not only to the teacher, but to the student as well, concerning the profitableness of the prevailing local types of farming. Farm-bureau men can hold farmers' meetings at which each farmer will be furnished with a copy of the blank to figure out his own labor income. Later meetings may be devoted to a discussion of the results. Work of this kind will reveal the true status of the local agriculture, and show the real problems confronting the farmers. The information these blanks will give when filled out properly should lead to a helpful discussion of many problems in farm management. The blanks can also be filled in by individual farmers and sent to the State agricultural college or to the United States Department of Agriculture for suggestions regarding possible improvements in their system of operation. Since more than one-third of the farms in this country are

operated by tenants, the blanks have been designed for use in analyzing the business of a farm operated by either the owner or a tenant.

FARM ACCOUNTS.

In making a record of the farm business, the need of some accounts will be evident if the labor income is to be determined accurately. Studies covering a large number of farms show that farmers keep many of the more important records. Some men will need accounts on the amount expended for labor, others on the amount paid for feed, and others on the amount of crops marketed or eggs sold. A memorandum of such items will prove especially valuable when summarizing the year's business. The problem of farm accounting is not a question of a particular kind of form or blank, but of knowing what accounts to keep and what use to make of them. This method of farm analysis will suggest such accounts as are needed.

METHOD OF FARM ANALYSIS.

The blank forms outlined on pages 17 to 26 have been prepared for use in determining the net income from the farm business. It is evident that the wide variation in the kinds of farming carried on in different parts of the country renders it impossible to devise a single set of blanks that will meet all conditions. The forms must therefore be general. For certain types of farming it will be necessary to insert items not printed in the blank forms.

FARM YEAR.

The period covered by such a record as is outlined in this bulletin is known as the farm year (blank form, p. 17). The date when this year begins varies from March 1 or April 1 in the Northern States to January 1 in the Southern States, and even to October 1 in some of the Western States. It corresponds to the date on which tenants change farms.

FARM TENURE.

For the purpose of this study a farm is understood to be all the land operated as one unit. It may consist of both owned and rented land, if all this area is operated by one set of machinery, horses, workmen, etc. In the case of a man owning two farms operated independently, each should be considered as a separate farm. As the blanks are designed for both tenant and owner farms, there are two columns under most headings. The operator is the person who lives on the farm and actually works it. Thus, if the owner works the farm he is the operator; but if the farm is rented the owner is the landlord and the tenant is the operator. A man owning one farm and renting additional land, all of which is operated as one farm, is classed as an owner operator.

FARM AREA.

The item "Total acres operated" (blank form, p. 17), includes all the land operated as one farm; and the number of acres that are owned, share-rented, or cash-rented should be shown under the proper headings. The total area operated is separated into four divisions, namely, (1) acres in woods; (2) acres in roads, building lots, etc.; (3) acres in pasture, and (4) acres in crops. Where more than one crop is grown on the land during the year the acreage this crop used should be counted once only in arriving at the acres in crops.

CROP RECORD.

The blank form for the crop record is shown on pages 18 and 19. Certain crops which are not listed will be grown in many parts of the country. These can easily be written in, using the blank spaces or the places of the names of crops not grown in the locality. The sum of the acres in the several crops should equal the "Acres in crops" shown on page 17. If a second crop is grown on a field during the year it is well to inclose its area in a circle, to save confusion when adding up the area in crops. Under sales all amounts sold from the farm or held for sale should be entered. Crops fed to live stock on the farm would not be counted as a sale. Crops on hand from the previous year which are held for sale need not be considered, as they do not belong to this year's business, but crops on hand from the previous year held for feed must be considered under "Feed and supplies" (p. 24).

On tenant farms, the tenant's crop sales and crops held by him for sale are listed under the heading "Operator's sales," while the landlord's crop sales, including the crops held by him for sale, are placed under the heading "Landlord's sales." Where the landlord transfers his share of the crops to be fed on another farm, the value of these should be credited as a sale on the account of the farm from which they are removed. Where men own and operate their farms and rent additional land, the sales from the crops on their own farms and their share of those on the rented land come under the heading "Operator's sales." The "Landlord's sales" columns should not be used except on share-rented farms and then only when the landlord's income is desired.

LIVE-STOCK RECORD.

The blank form for the live-stock record is shown on pages 20 and 21. This needs very careful attention. It includes a record of the number and value of all live stock on hand at the beginning and at the end of the year, all sales and purchases made during the year, and the number that died during the year. There will be a variation according to the number bought, sold, or raised. The number on hand at the

beginning of the year, plus the number purchased and the number raised, must equal the number on hand at the end of the year, plus the number sold and the number that have died. It often happens that the number of dairy cows is increased the second year by the addition of heifers which were counted as yearlings in the first inventory. In the same way spring calves which might not appear at all in the first inventory would be counted as yearlings at the end of the year. Again, the calves born and sold during the year will not appear in either inventory, but they will appear in the sales. This holds equally true for all the classes of live stock. In estimating the value of live stock, market values at the time should be used. On all farms except where the landlord owns a share of the live stock, the record is made under the heading "Operator's stock."

LIVE-STOCK SUMMARY.

The space under the heading "Live-stock summary" (p. 22) is for a concise statement of the live-stock enterprise. Add the total of the receipts from stock products, sales of live stock, and the inventory value of the live stock at the end of the year. From this sum subtract the amount paid for purchases plus the inventory value at the beginning of the year. The result will give the "Net increase" for the live-stock part of the farm business.

RECEIPTS.

Stock products.—The receipts from live-stock products, such as milk, butter, eggs, and wool, should be entered in the spaces of the first form on page 22. These include the value of all products sold from the farm. They do not include the value of milk, eggs, butter, or meat used in the farm home. If eggs or other products are exchanged for supplies, their value should be counted as a sale.

Miscellaneous sources.—Under "Receipts, miscellaneous sources" (p. 22), such items as money received for teaming, machine work for neighbors, and the like are placed. If there is a tenant house on the farm which is rented to some person not connected with the farm, the rent from this should be considered a receipt, provided the value of this house is counted as a part of the farm real-estate value. Where a large quantity of lumber is sold during any one year, credit should be allowed for only the amount which would normally be sold each year.

CURRENT EXPENSES.

The items of farm expense will vary widely, according to the kind of farming followed and the region. The list of items given on page 23 may not be complete for all farms, and important items should be written in if they are not listed. The third item, relating to board of both regular and extra help, includes the expense for its preparation

and that part of the board purchased, i. e., no expense for the part of the board that the farm furnishes should be charged against the farm. If such a charge is made, it is necessary to credit the farm with those products used in the farm living. This method would mean extra work and considerable estimating; hence, it is not believed desirable, particularly as the labor income will be the same in either case. The cost of preparation and the proportion of the board ordinarily purchased in the form of groceries, meats, etc., varies from one-third to two-thirds of the total value of the board. The value of unpaid family labor is counted as part of the farm expenses, the same as is hired labor. This refers to farm work only and not to household labor. The value of the operator's or farmer's own labor should not be included. (See form on page 23 for this item.) The board chargeable for family labor is figured on the same basis as for hired labor.

Labor expended in the construction of new buildings, tile drains, or other permanent improvements should be included with the expense for materials under the items "New buildings," "Tile drains," etc. (p. 23), and should not be listed under the labor items at the top of the preceding form. The item of depreciation on fences is included in "Repair of fences" under "Current expenses" (p. 23).

DEPRECIATION OF EQUIPMENT AND BUILDINGS.

In addition to the current farm expenses there are certain other items, such as depreciation, which may be called fixed charges. These occur on all farms to a greater or less extent. Buildings may be constructed so that they will last for 100 years, or they may have to be rebuilt every 25 or 30 years. The life of machinery depends on the care given and the extent to which it is used. Although there is no appreciable expense each year, these buildings and machines eventually have to be replaced. It is proper that a proportionate share of this replacement cost should be charged against the farm each year; otherwise, whenever a new barn or dwelling is built the entire cost of this building would have to be charged against the business for that particular year. Depreciation charges, therefore, are merely a method of uniformly distributing these costs over the period of years that they are in use.

The annual depreciation on buildings will vary from less than 1 per cent on very substantial stone or brick buildings to as high as 3 or 4 per cent on frame buildings. The rate of depreciation on machinery will vary from 5 to 20 per cent, depending on the implement and the way it is used. Probably from 7 to 12 per cent a year would be approximately correct for most farms. The amount of depreciation that should be charged each year as an expense (p. 23) is left to the judgment of the person making the record. No set rules can be given, as no two farms are exactly alike in this respect.

PERMANENT IMPROVEMENTS AND NEW EQUIPMENT.

The spaces under the heading "Improvements" are for enumerating the cost of new buildings, fences, tile drains, and machinery. In computing the farmer's income it is not necessary to take expenditures for permanent improvements into account, because if they are included at all they appear both in the expense items and in the inventory items showing an increase and the entries cancel each other in the final calculations. The record of such improvements may therefore be treated as a memorandum for future reference, but it is not to be used in calculating the year's profits or losses.

LIST OF MACHINERY.

The blank form on page 24 is designed to cover all farm implements. The value stated for each machine should be a fair price for it, according to its condition at the beginning of the farm year. This price should not represent what it might sell for, but its value compared with a new machine. New implements purchased during the season should be listed under "Improvements" (p. 23) and not under "Current expenses." As the list of machinery is general, there will be some items of equipment on certain farms which are not given in this enumeration. These should be inserted at convenient places.

FEED AND SUPPLIES.

The quantity of feed and supplies on hand at the beginning and at the end of the year is important, as any increase or decrease in this represents a gain or loss (p. 24). This quantity will vary according to the time the farm year begins. Thus, if it begins on April 1, ordinarily only enough roughage or grain will be on hand to last until the new crops are harvested. As previously stated, grains or hay held for sale are not included with those held for feeding purposes. The reasons for accounting for these items of feed and supplies are that they form a part of the farm investment, and also represent an increased or decreased item of income in the year's business.

FARM CAPITAL.

Farm capital, or farm investment, includes the total value of all land, buildings, live stock, tools, machinery, feed, supplies, and cash to run the business. The several steps to be observed in using the form shown on page 25 are given below:

Real estate.—Under real estate is included the value of the land, buildings, fences, and water supply. Normal farm values should be used and not high speculative prices or assessed valuations. Using values that are too high or too low causes results which may look well on paper, but which are of no use to the owner. If the farm is mort-

gaged, no account of this should be taken, as the total farm investment is wanted and not how much of it is actually owned.

Live stock.—For the item of live stock, the total inventory value of live stock at the beginning of the year should be transferred from page 22.

Machinery.—The value of the farm machinery for the beginning of the year is brought forward from the total on page 24.

Feed and supplies.—For the item of feed and supplies the total for the beginning of the year should be transferred from page 24.

Cash.—The item of cash to run the farm varies widely on different farms. It should represent the average amount of money the farmer has on hand at all times during the year for the purpose of paying current expenses, in other words, the average of his checking account. On a dairy farm, this amount would be about equal to the milk or cream check. On a tobacco or cotton farm, where there is only one crop and no money coming in except at one time, it would mean a sum nearly equal to the entire year's running expenses. The amount of cash necessary to run the business will range from $25 to $100 on most farms.

The final step is to add together these five items, in order to obtain the total of the farm investment.

FARM SUMMARY.

The blank form on page 25 is for a summary of the farm business. The items for this summary are taken from the totals in the preceding forms, as follows:

Capital.—The total farm capital, from the form immediately preceding, is the first item. This is the farm investment on which interest should be charged.

Receipts.—Under receipts, enter these totals: Crop sales, from page 19; live stock net increase, from page 22; receipts, miscellaneous sources, from page 22; and the increase, if there is any, in feed and supplies, from page 24. The sum of these four groups represents the total of the farm receipts.

Expenses.—Under expenses, enter these totals: Current expenses, from page 23; depreciation, from page 23; and decrease in feed and supplies, if any, as noted on page 24. The sum of these three groups represents the total farm expenses.

Farm income.—Subtract the total expenses from the total receipts. This will give the net farm income, which is the money received for the use of the capital and pay for the operator's labor. But capital has an earning power, which at least equals the current rate of interest on well-secured farm loans. Interest at this rate should be deducted.

Labor income.—Subtracting the amount of this interest from the farm income gives the farmer's labor income.

The labor income represents the amount of money the farmer has left after paying all business expenses of the farm and deducting interest on the money invested in the farm business. In addition to the labor income the farmer has the use of the farmhouse and the products that are furnished by the farm toward his living, such as fruit, garden vegetables, dairy products, and fuel. In other words, the labor income is comparable with a hired man's wages when the hired man gets a house and garden and some farm products.

The difference between receipts and expenses, or farm income, will not necessarily correspond to the money on hand or in the bank, as personal and living expenses have to be paid out of this amount. Furthermore, in the case of farmers having mortgages or other debts, the interest on these, as well as any principal paid, must come out of the farm income. Therefore, the record of the farm business may show a fairly large difference between the receipts and expenses, and yet the farmer may not have any money to show for it at the end of the year, owing to the fact that the funds have been spent for living or for personal uses or have been put into other investments, such as insurance and paying off the mortgage. The object of this record is to analyze the farm business; that is, to ascertain how much the farmer makes, not to determine how much he actually saves. Having learned what the farm is returning, the responsibility rests with the farmer as to how much he spends personally or uses in other ways.

COMPARISON OF THE FARMER'S LABOR INCOME WITH THE SALARIES OF CITY MEN.

The farmer's labor income can not be compared with the salary that the city man receives. In the first place, the farmer's business and home are very closely associated. There is a large proportion of his living for which the farmer does not have to pay cash. The value of house rent and the products contributed by the farm, such as garden vegetables, milk, etc., are important items for which the city man must pay out a large proportion of his income. Moreover, the farmer is not a mere laborer. He has money invested, and he is entitled to interest on his investment as well as pay for directing a business; whereas the city man who works for a salary places his funds in a residence or some other form of investment not associated with his work. The salaries city men receive look very large to the farmer, while the labor income that the farmer receives looks small to the city man when all these other factors are not given proper consideration. It may seem strange that a farmer with a small or even a minus labor income may still live comfortably. Even 2 or 3 per cent on his investment, if the latter is sufficiently large, may represent a good living, particularly if the farmer is free from debt. On the other hand, if the farm income—that is, the difference between receipts and expenses—is a minus quantity, then the farmer must soon have other means of support.

MEASURES OF FARM EFFICIENCY.

There are certain factors on which the success of a farm business usually depends. From these it is usually possible to determine not only the good points in a system of farming, but also its deficiencies. The latter being known, the method of improving the system becomes evident.

On a great majority of farms, success is primarily dependent on three important factors. These are (1) the size of the farm business; (2) the yields of the crops and the returns per animal, representing the quality of the farm business; and (3) the diversity of the business. Of course many other things have their influence, but the farmer whose business is efficient in these three respects is generally successful. Those farms that are excellent in none of these respects almost universally fail. Those deficient in one or two may succeed, but their chances of success are greatly lessened.

SIZE OF THE FARM BUSINESS.

There are three ways of measuring the size of the farm business: (1) The amount of capital invested, particularly working capital; (2) the area in crops; (3) the number of day's labor required in the operation of the farm. The last measure is best, especially in comparing different types of farming. Forty acres of truck and general crops may, under suitable conditions, equal a 200-acre farm devoted to grain and hay, both as to labor required and income received.

There is reason to believe that more farmers have meager incomes because of the smallness of the business conducted than from any other cause. So many deceive themselves into thinking that their farms keep them busy the entire year, when, as a matter of fact, the actual results accomplished represent less than a half year's work. An acre of hay normally requires 10 hours of man labor, or approximately one day's work for each cutting; an acre of wheat, 20 hours; an acre of potatoes, 80 to 110 hours; caring for and feeding a dairy cow, about 150 hours per year. Only about 250 to 275 days are actually available for productive work. Much time is lost in odds and ends about the farm which take time but really count for little. A farmer may keep busy the whole year, but if he has accomplished during that time only such work as should normally be done in 200 days his wages will be in proportion. Farming, just as any other business, will not pay for inefficient labor. Work that creates something of value is what counts on the farm.

WAYS OF INCREASING THE SIZE OF THE FARM BUSINESS.

There are several ways of increasing the size of the farm business:

(1) The buying or renting of more land. A man who owns a small area can often rent additional land which adjoins his farm. This practice is followed by many farmers, especially in the Central States.

It permits the use of a larger area with comparatively little additional capital. More land gives more work and permits a better utilization of labor and equipment.

(2) The growing of crops requiring more labor; that is, following a more intensive form of farming. A hundred acres devoted to corn, oats, wheat, etc., which would not be sufficient to keep two men busy, can easily be increased to a full 2-man farm by the addition of a few acres of such crops as beets, potatoes, or fruit. The profitable production of these crops will depend on whether there is a market for them. A great many persons have made the mistake of buying a small area, with the idea of following an intensive type of agriculture in localities where there is no market for the products of such farming. The fact that land is adapted to truck crops is not sufficient justification for attempting to grow them. There must be the possibility of disposing of the products at remunerative prices.

(3) The putting of more labor on the same crops, as well as taking better care of the live stock. But it is easily possible to overdo the matter in this respect. In applying labor to any enterprise a point is reached beyond which it will not pay to go.

(4) The addition of more live stock, even beyond the point where the farm itself will support them. This necessitates the purchase of feed and is a practice followed by a large number of dairy farmers in some of the Eastern States, where the nature of the land is such as to prohibit the raising of grain as cheaply as it can be bought. In using this method of increasing the size of the farm business only loss will result unless the additional animals are of high-producing quality. This is the one way open to many farmers whose business would otherwise be too small to give them a good living. The success of many farms is in large measure dependent upon the number of cows or live stock that can be kept.

(5) The doing of outside work, such as teaming or working at lumbering during the winter. In many farming regions there is no opportunity for this source of income.

No one realizes better than the farmer that as a rule no phenomenal profits can be expected, and persons going into farming as a business must remember this fact. Agriculture is a good life work; it will pay living wages and moderate returns on an investment, provided both capital and labor are wisely expended. Success is most difficult to attain, however, unless the farm business is large enough to permit the efficient use of both capital and labor.

EFFICIENCY OF LABOR.

Owing to the exceedingly diverse nature of farm operations there is abundant opportunity for inefficiency to enter into their performance. In a factory with modern machinery a man is expected to do a certain amount of work. He is aided in doing this by standard

machinery, which in many instances sets the pace for him. On the farm it is different; there are but few standards of farm labor, few measures of how much work a man should do in a day. Generally the worker must be his own boss and must set his own pace. He must also work under most adverse weather conditions at certain times. It is perfectly evident that innumerable factors will influence the time required for most operations. They can not be standardized as work is in a factory. Some men are naturally slow and take twice as much time as others to do certain kinds of farm work. There has been considerable investigation of this subject, but not enough to give reliable standards of farm labor for all conditions. Table I gives approximate standards for average conditions for certain classes of work. These, or such modifications of them as local experience may render advisable, may be used in working out the approximate amount of both man and horse labor required to operate a given farm.

TABLE I.—*Approximate work units needed for the production of crops and in caring for live stock, etc., a work unit being a 10-hour day of man or horse labor.*

Operation.	Work units (10-hour days).	
	Man.	Horse.
Production of crops (per acre):		
Timothy, alfalfa, and clover hay, per cutting	1	1
Oats, wheat, barley, rye, buckwheat, and millet	2	3
Corn husked from standing stalks, corn-belt States	2 to 3	5
Corn husked from shock	6	6
Corn for silo	4 to 6	5 to 7
Corn husked, Southern States	3 to 4	3 to 4
Potatoes	8 to 12	10
Cotton	8 to 12	4 to 6
Sugar beets	7	7
Melons	4	2
Cabbage	13	12
Peanuts	3	1
Sorghum sown broadcast, cut for hay	4	4
Tobacco	20	7
Field beans	5	5
Apples	15	5
Caring for live stock (per year):		
Horses, corn-belt States	8	1
Horses, Eastern States	12	1
Dairy cows	15 to 20	1 to 2
Young stock, cattle, colts, etc	2½ to 3	¼
Ten hogs, corn-belt States	10	2
Ten hogs, Eastern States	20	2
Ten brood sows and raising pigs to weaning	30	5
100 ewes	50	5
100 chickens (well cared for)	15 to 25	1

RECEIPTS FROM LIVE STOCK.

The importance of having efficient live stock is well understood. By efficient animals is meant those that will more than pay for the cost of keeping. On the majority of farms, except in the Southern and certain of the Western States, more of the crops are fed to live stock than are sold direct. In fact, on many farms none of the feedable crops are sold. The animals are then the market, and the price

they return for these crops is measured by their efficiency. The best of corn crops and hay count for little when sold to animals that return much below market prices for them.

DIVERSITY OF FARM ENTERPRISES.

In most cases where studies on the profits in farming have been made, particularly in our oldest agricultural districts, such studies indicate that the most successful farms are those which have from two to four major sources of income; i. e., they have a well-balanced and diversified business. In certain instances it may pay better to have only one enterprise, but usually when one crop pays much better than all others the production of it increases rapidly and soon the price falls to the point where other crops or products are equally as profitable. Diversified farming is often confused with farming where there is a little of everything and not much of anything. Either extreme lessens the chances of success. When the price of certain crops is very low then live stock usually becomes desirable. However, if the returns per animal are poor, cash crops even at a low price are essential. A well-balanced business insures against losses and provides a much better utilization of the labor and equipment.

BLANKS FOR USE IN ANALYZING THE FARM BUSINESS AND DETERMINING THE FARM INCOME.

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Farm Area.

State.....Farm year beginning....., 191..

Operator.....P. O. address.....

Landlord.....P. O. address.....

Township.....Miles to railroad.....

Location.....

Acres owned.....Acres cash rented.....

Acres share rented.....Total acres operated.....

Acres in woods.....Acres in roads, building lots, etc.....

Acres in pasture.....Acres in crops.....

Crop Record.

Crops.		Yield.		Operator's sales.			Landlord's sales.		
Kind.	Acres.	Per acre.	Total.	Amount.	Price.	Value.	Amount.	Price.	Value.
Corn for grain									
Corn for silage									
Other corn									
Potatoes									
Spring wheat									
Winter wheat									
Rye									
Oats									
Barley									
Buckwheat									
Straw									
Hay									
Alfalfa									
Oat hay									

Oats and barley										
Oats and peas										
Field beans										
Cabbage										
Tobacco										
Cotton										
Hops										
Beets										
Seeds										
Apples, bearing										
Apples, not bearing										
Peaches										
Cherries										
Pears										
Strawberries										
Total										

Live-Stock Record.

Operator's stock.

Animals—kind.	Beginning of farm year.			End of farm year.			Sales.			Purchases.			Died.
	No.	Value.	Total.	No.	Value.	Total.	No.	Value.	Total.	No.	Value.	Total.	No.
Cows													
Heifers													
Calves													
Bulls													
Steers													
Oxen													
Horses													
Mules													
Colts													
Ewes													
Lambs													
Brood sows													
Other hogs													
Pigs													
Chickens													
Turkeys													
Ducks													
Bees													
Total													

LANDLORD'S STOCK.

Animals—kind.	Beginning of farm year.			End of farm year.			Sales.			Purchases.			Died.
	No.	Value.	Total.	No.	Value.	Total.	No.	Value.	Total.	No.	Value.	Total.	No.
Cows													
Heifers													
Calves													
Bulls													
Steers													
Oxen													
Horses													
Mules													
Colts													
Ewes													
Lambs													
Brood sows													
Other hogs													
Pigs													
Chickens													
Turkeys													
Ducks													
Bees													
Total													

RECEIPTS FROM STOCK PRODUCTS.

	Amount.	Price.	Operator.	Landlord.
Butter				
Creamery milk				
Market milk				
Cheese				
Wool				
Eggs				
Hides				
Honey				
Breeding fees				
Total				

LIVE-STOCK SUMMARY.

	Operator.		Landlord.	
Stock products				
Stock sold				
Value of live stock at end of year				
Total	→		→	
Live stock purchased				
Value of live stock at beginning of year				
Total	→		→	
Live stock, net increase				

RECEIPTS, MISCELLANEOUS SOURCES.

	Amount.	Price.	Operator.	Landlord.
Labor				
Machine work				
Cash rent for				
Rent of buildings				
Sirup and sugar				
Lumber, posts, etc				
Total				

CURRENT EXPENSES.

	Operator.	Landlord.
Regular hired labor.....mo..		
Extra hired labor.....mo..		
Board hired labor.....mo..		
Family labor.....mo..		
Board of family labor		
Repair of machinery		
Repair of buildings		
Repair of fences		
Feed: Hay, silage, etc		
Feed: Grain and concentrates		
Feed grinding		
Silo filling		
Corn shredding		
Milk hauling		
Horseshoeing		
Breeding fees		
Veterinary		
Seed, plants, trees		
Fertilizer, manure		
Spray materials		
Twine		
Thrashing		
Baling		
Machine work hired		
Fuel and oil for farm work		
Bags, barrels, crates		
Cotton ginning		
Insurance		
Taxes on farm property		
Water tax		
Cash rent		
Total		

DEPRECIATION ON EQUIPMENT AND BUILDINGS.

Dwelling, .. per cent of value		
Other buildings, .. per cent of value		
Machinery, .. per cent of value		
Total		

Value of dwelling ..... of tenant house.....
Of other buildings ..... Total buildings.....
Estimated value of farmer's own labor.....

IMPROVEMENTS.

	Operator.	Landlord.
New buildings		
Fences		
Tile drains		
New machinery		

LIST OF MACHINERY.

No.	Kind.	Value at beginning of year.	No.	Kind.	Value at beginning of year.
.....	Heavy wagons.....	.....	.....	Mowing machine....	.....
.....	Light wagons.....	.....	.....	Hayrake	.....
.....	Pleasure wagons....	.....	.....	Tedder.....	.....
.....	Sleighs.....	.....	.....	Hayfork and stacker	.....
.....	Walking plows.....	.....	.....	Manure spreader....	.....
.....	Sulky plows.....	.....	.....	Corn shredder.....	.....
.....	Disk harrow.....	.....	.....	Ensilage cutter.....	.....
.....	Spike-tooth harrow..	.....	.....	Corn sheller.....	.....
.....	Spring-tooth harrow.	.....	.....	Potato planter.....	.....
.....	Roller.....	.....	.....	Potato sprayer.....	.....
.....	Weeder.....	.....	.....	Potato digger.....	.....
.....	Corn planter.....	.....	.....	Orchard sprayer....	.....
.....	1-horse cultivator...	.....	.....	Gasoline engines....	.....
.....	2 or 3 horse cultivator	.....	.....	Dairy equipment...	.....
.....	Corn binder.....	.....	.....	Poultry equipment..	.....
.....	Grain binder.....	.....	.....	Evaporator.....	.....
.....	Grain drill.....	.....	.....	Harness.....	.....
.....	Hay loader.....	.....	.....	Minor equipment...	.....
.....	.....	.....	.....	.....	.....
	Total.....				.....

FEED AND SUPPLIES.[1]

	Beginning of farm year.			End of farm year.		
	Amount.	Price.	Value.	Amount.	Price.	Value.
Hay.....	.....	.....	.....	.....	.....	.....
Wheat.....	.....	.....	.....	.....	.....	.....
Oats.....	.....	.....	.....	.....	.....	.....
Corn.....	.....	.....	.....	.....	.....	.....
Straw.....	.....	.....	.....	.....	.....	.....
Silage.....	.....	.....	.....	.....	.....	.....
Seed.....	.....	.....	.....	.....	.....	.....
Other supplies...	.....	.....	.....	.....	.....	.....
Total.....			.....			.....

Feed and supplies: Decrease..... Increase.....

[1] In case the landlord owns a share of the feed and supplies, make the proper division when transferring to the summary. If the total value of the feed and supplies on hand at the end of the year is greater than at the beginning, the difference is an increase; if less, a decrease.

CAPITAL.

	Beginning of farm year.	
	Operator.	Landlord.
Real estate (p. 7)		
Live stock (p. 22)		
Machinery (p. 24)		
Feed and supplies (p. 24)		
Cash		
Total		

SUMMARY.

	Operator.		Landlord.	
	Item.	Total.	Item.	Total.
Capital	→		→	
Receipts from:				
Page 19, Crop sales				
Page 22, Livestock, net increase				
Page 22, Miscellaneous				
Page 24, Increase feed and supplies.				
Total receipts	→		→	
Expenses:				
Page 23, Current				
Page 23, Depreciation				
Page 24, Decrease in feed				
Total expenses	→		→	
Farm income				
Interest on capital, ..per cent [1]			Per cent received on investment	
Farmer's labor income				

[1] Use current rate of interest on well-secured farm loans.

SOME TESTS OF FARM EFFICIENCY.

Number of crop acres per work horse.....

Number of months of man labor, including operator's.....

Number of man-labor years [1].....

Number of crop acres per man [2].....

Percentage of total investment in real estate.....

Investment in buildings per crop acre.....

Number of animal units [3].....

Investment in barns per animal unit.....

Number of productive man-work units [4].....

Number of productive man-work units per man.....

Man-labor cost per productive work unit [5].....

Net receipts per animal unit [6].....

Value of feed consumed per animal unit [7].....

Milk receipts per cow.....

[1] Divide number of months of man labor by 12. This gives the number of man-labor years.

[2] Divide number of crop acres by number of man-labor years.

[3] In figuring the amount of live stock on the farm, it is necessary to have some basis for comparing the different kinds of animals. One horse, cow, or steer is equivalent to one animal unit; two head of young stock (of the above kinds) are counted as one animal unit; 7 sheep, 14 lambs, 5 hogs, 10 pigs, or 100 chickens are each counted as one animal unit.

[4] In order to have a basis for computing the time required for different farm operations, a normal day's labor of 10 hours is considered a work unit. See page 12 for table giving list of work units.

[5] Find the cost of all farm labor, including value of operator's, and divide by the number of man-work units.

[6] Divide the net increase under live-stock summary (p. 22) by the number of animal units, not including work horses.

[7] Find the total at farm prices of the value of all crops fed, plus a charge for pasture, plus amount of feed bought, and plus or minus the difference in the feed inventory, and divide by the number of animal units.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 662 MAY 11, 1915

Contribution from the Bureau of Entomology, L. O. Howard, Chief.

THE APPLE-TREE TENT CATERPILLAR.[1]

By A. L. QUAINTANCE,

In Charge of Deciduous Fruit Insect Investigations.

INTRODUCTION.

The conspicuous, unsightly nests or tents of the apple-tree tent caterpillar (fig. 1) are familiar objects in the spring in trees along roadways, streams, and fences, in neglected orchards, and elsewhere.

The gregarious caterpillars construct the tents for their protection, and these, at first small, are gradually enlarged as the larvæ grow, often to a foot or more in height and diameter, the size varying with the number of individuals in the colony. The caterpillars feed upon the foliage of the trees, stripping the leaves from the limbs adjacent to the nest, and if there be several colonies in a tree, as is frequently the case during periods of abundance, the foliage may be quite destroyed, leaving the branches as bare as in midwinter (fig. 2).

DISTRIBUTION AND FOOD PLANTS.

The tent caterpillar is a native American species occurring quite generally in the United States from Canada south to Florida and westward about to the Rocky Mountains. From the Rockies to the Sierras, according to Dyar, the species is replaced by another of the same genus,[2] which ranges from Canada to Mexico, and this latter form in the Pacific Northwest is replaced by still another species.[3]

The tent caterpillar has been a troublesome pest from the earliest times. As stated by Fitch, its injuries in Massachusetts in the years 1646 and 1649 led the early settlers to term these "caterpillar years." At rather long and irregular intervals the caterpillars have been excessively abundant in different parts of their range, but more

[1] *Malacosoma americana* Fab. [2] *Malacosoma fragilis* Stretch. [3] *Malacosoma pluvialis* Dyar.

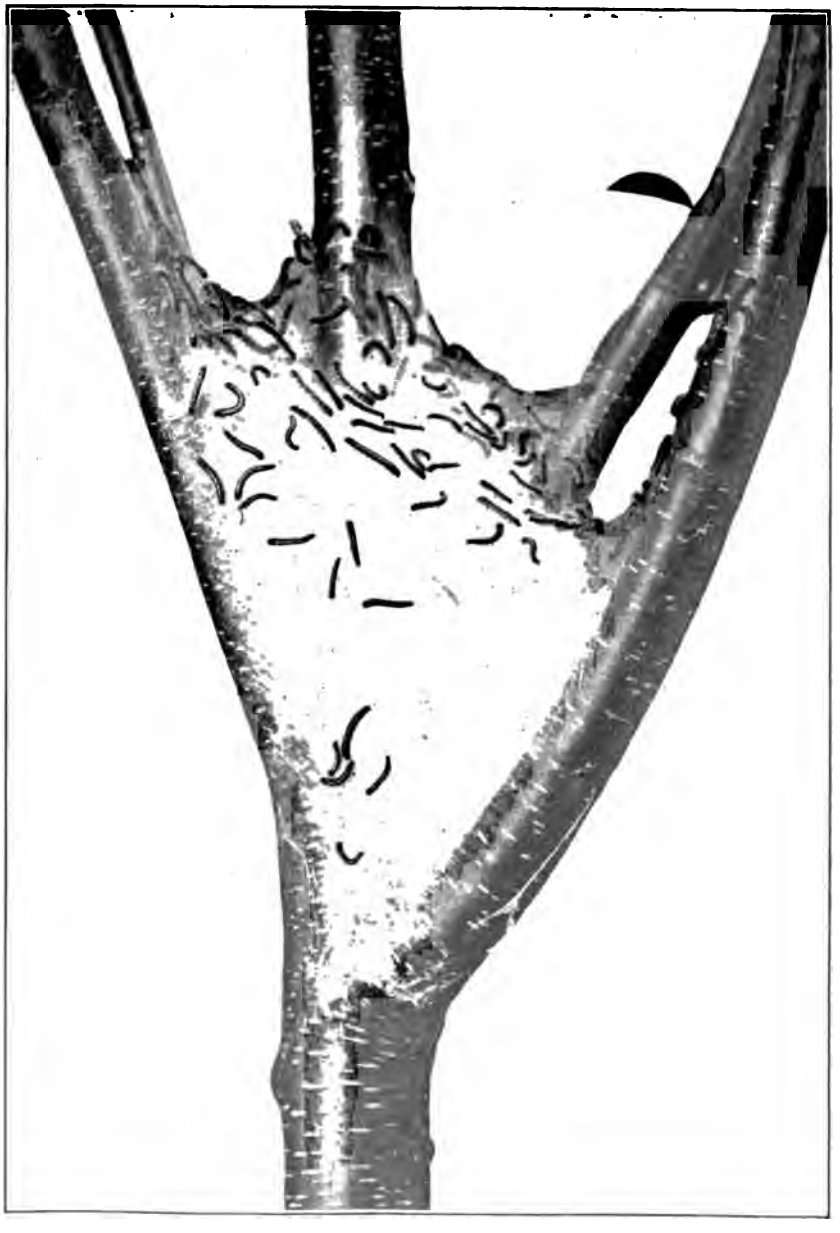

FIG. 1.—Nest and larvæ of apple-tree tent caterpillar in crotch of wild cherry tree. (Original.)

particularly in the New England States. This species was among the first to receive attention by the early American entomologists, and the principal features in its life and habits have been known for many years. Throughout its extended distribution the insect is likely to be abundant each year in one or more localities and often over a considerable territory. Scattered nests are to be found usually during any spring, although in some seasons these are but little in evidence.

FIG. 2.—Nests of apple-tree tent caterpillar in wild cherry tree which the larvæ have defoliated. (Original.)

The favorite food of the tent caterpillar is the wild cherry, and this is probably its native food plant. Next to the wild cherry the apple is apparently preferred. In the absence of its favorite food, or under special conditions, it attacks many other plants, as plum, peach, thorn, pear, rose, and other members of this group, as also beech, witch-hazel, elm, maple, and various species of willows, oaks, and poplars. During periods of unusual abundance trees are more or less completely defoliated, and at a time when they most need the leaves for their growth or for the development of the fruit, and they are materially weakened, though rarely killed.

DESCRIPTION AND LIFE HISTORY.

THE EGG.

Eggs are deposited in masses or belts encircling the smaller twigs, as shown in figure 3. Different egg masses may vary from one-half to three-fourths of an inch in length and contain from 150 to 250 eggs. The average number of eggs in several egg masses counted by Prof. V. H. Lowe on peach and apple was about 223 each. Each egg belt is deposited by an individual female and ordinarily represents the entire number which she will deposit. Eggs are placed on end, cemented closely together, the whole oval-shaped mass being finally covered with a layer of light-brown frothy glue, which soon becomes tough, brittle, and glistening.

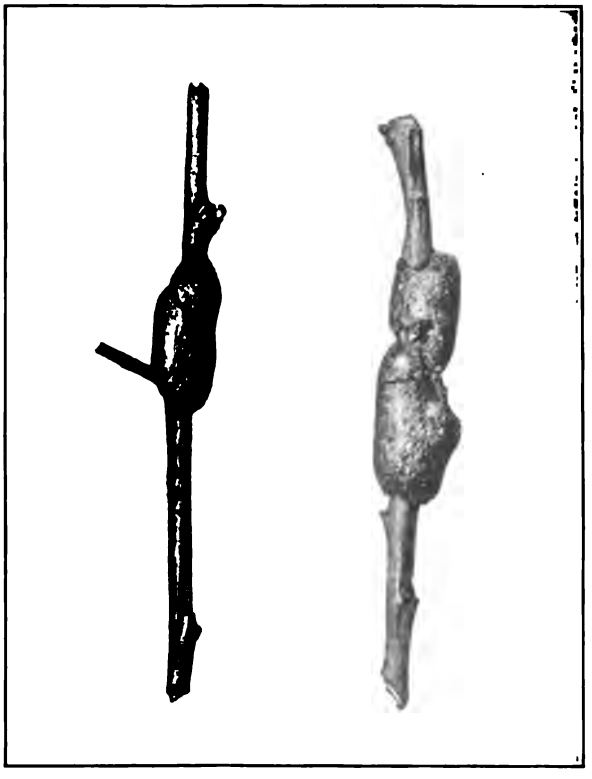

FIG. 3.—Egg masses of apple-tree tent caterpillar. Slightly enlarged. (Original.)

Eggs are deposited by the moths by early midsummer, or earlier in the South, the embryonic larvæ developing so that by fall they are practically full grown, although remaining within the egg until the following spring. With the coming of a warm spell the larvæ escape by gnawing through their eggshells, often before there is foliage out for food, and under these circumstances they may feed upon the glutinous covering of the egg mass.

THE LARVA.

In the presence of food the larvæ begin the formation of their nest in about two days from hatching, usually selecting the crotch formed by two limbs and ordinarily one that is not far from the egg mass. The caterpillars are sociable, those from one egg mass inhabiting one nest and feeding together upon the adjacent leaves. If two egg masses happen to be deposited close together, as on the same or

adjacent twigs, the resulting caterpillars may unite in one nest. Wherever they go each larva spins a thread of silk, the young individuals hanging suspended from a silken thread when they drop, as do the cankerworms and many other larvæ. The nests, at first small and affording but little shelter, are gradually enlarged as the caterpillars grow and soon furnish ample protection. Upon close examination the nests of this species will be found to be made up of layers of silk, with room for the larvæ between the layers. According to Fitch these layers are the result of the caterpillars' habit of lying on the outside of the nest during bright weather, the few restless individuals crawling back and forth over the resting mass, spinning silk

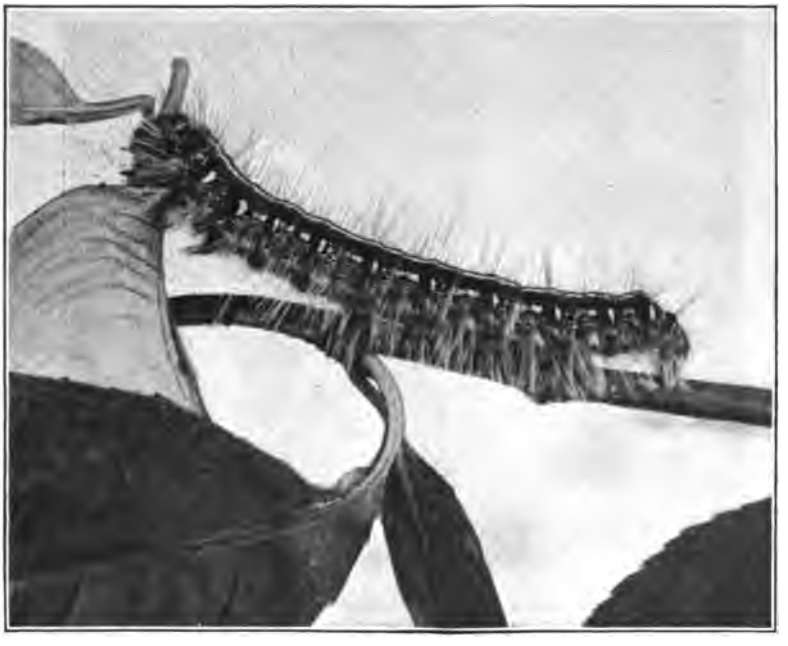

FIG. 4.—Full grown apple-tree tent caterpillar. About twice natural size. (Original.)

as they go, soon forming a new layer. During rainy and cloudy weather the larvæ remain mostly within the nest, but when the weather is favorable they feed at regular intervals; according to Fitch, in the morning, in the afternoon, and again during the night. Upon becoming nearly full grown the larvæ wander singly away from the nest, feeding upon such plants as come to hand. This wandering habit preparatory to pupation results in the scattering of the pupæ and greatly increases the chances of their escape from destruction from their numerous natural enemies.

When full grown the caterpillars are about 2 inches long, cylindrical, deep black, with a white stripe along the back, and lateral markings, as shown in figure 4. On each side is a row of oval pale-

blue spots, one on the middle of each segment, and on the anterior side of each is a broader, deep velvety black spot. The body is sparsely clothed with fine, soft, yellowish hairs of varying length, thickest perhaps toward the anterior end, where they project forward over the black-colored head. In about six weeks from hatching the larvæ become full grown and wander away from the nest, as stated, in search of suitable places for pupation.

THE COCOON.

The larvæ select for pupation any convenient, more or less secluded place, as under loose bark, in grass or brush under trees, along fences, etc. If close to outbuildings the larvæ often make their cocoons in

FIG. 5.—Cocoon and pupa of apple-tree tent caterpillar. About twice natural size. (Original.)

the angles along the sides, in window casings, etc. The cocoon, shown in figure 5, at the left, is oval in shape, about 1 inch long, and composed exteriorly of coarse, loose, whitish threads of silk surrounding the tougher parchmentlike lining. The silk of the cocoon is intermixed with a yellow powdery substance, which readily comes off when disturbed. Cocoons are made more or less singly, although in suitable shelter near the nest several may be found spun together, the larvæ taking advantage of the same protection. Cocoons are frequently found within the nest, although these will usually prove to be parasitized.

THE PUPA.

Within the cocoon the larva changes to a short, oval, brownish pupa, as shown in figure 5, at the right. This stage lasts about three weeks, the time varying somewhat; then the moth appears.

THE ADULT.

Both sexes of the tent-caterpillar moth are shown in figure 6, the female to the right. These are dull reddish-brown, stout-bodied moths, with a wing expanse in the females of about 1.5 to 2 inches, and in the males of from 1.2 to 1.3 inches. Obliquely across the forewings of each sex are two nearly parallel whitish lines, as shown in the illustration. Soon after emergence the sexes mate, and eggs are deposited on limbs and twigs. There is only one generation each year, the insects existing in the egg stage throughout the remaining summer and fall and through the winter, the young larvæ coming from the eggs in early spring and forming their nests, or tents, as stated.

FIG. 6.—Moths of apple-tree tent caterpillar; male at the left. Slightly enlarged. (Original.)

NATURAL ENEMIES.

This species is subject to attack by numerous parasitic and predaceous enemies, which undoubtedly exert an important influence in keeping it reduced. Very minute, four-winged flies of the order Hymenoptera deposit their eggs within those of the tent caterpillar moth, the resulting larvæ or grubs finding sufficient food for their growth and development to parent flies. Three egg parasites have been recorded for this species.[1]

Larvæ and pupæ furnish food for a large number of parasites and hyperparasites. Thus W. F. Fiske [2] records a total of some 24 species of insects which directly or indirectly feed upon the tent caterpillar. Eighteen primary parasites have been recorded from the larva and pupa.[3]

[1] *Telenomus clisiocampae* Riley, *Pteromalus* sp., and *Platygaster* sp.

[2] Tech. Bul. No. 6, N. H. College Agric. Exp. Sta., p. 2 (1903).

[3] *Itoplectis conquisitor* (Say), *Itoplectis annulipes* (Brullé), *Pimplidea pedalis* (Cress.), *Iseropus inquisitoriella* (Dalla Torre), *Limnerium fugitivum* Say, *Ameloctonus clisiocampae* Weed, *Anomalon exile* Prov., *Anomalon anale* Say, *Spilocryptus extrematis* Cress., *Apanteles congregatus* var. *rufocoxalis* Riley, *Apanteles clisiocampae* Ashm., *Rhogas intermedius* Cress., *Hadrobracon hopkinsi* Vier. (mentioned in the reference given above as *Bracon gelechiæ* Ashm., an erroneous determination), *Diglochis omnivorus* Walk., *Miotropis clisiocampae* Ashm., *Theronia melanocephala* Brullé (?)—all Hymenoptera—and the dipteron *Frontina frenchii* Will.

Among predaceous insects are several species of ground beetles which are said to feed upon the larvæ, among them *Calosoma scrutator* Fab. Among the Hemiptera Mr. A. H. Kirkland has observed several species of Podisus[1] and the reduviid, *Diplodus luridus* Stål, attacking the larvæ. According to Prof. Bruner, *Podisus spinosus* Dall. and *Perillus claudus* Say also are enemies of the caterpillar.

While most birds as a rule do not feed on hairy larvæ such as the tent caterpillar, yet several species are known to include this insect in their diet, as the black-billed and yellow-billed cuckoos, the blue-jay, and, according to Mr. E. H. Forbush, the crow, chickadee, Baltimore oriole, red-eyed vireo, chipping sparrow, and yellow warbler. Kirkland states that the common toad feeds greedily on tent caterpillars, he having found in their stomachs the remains of from 15 to 20, and in one instance 37 of these larvæ.

FIG. 7.—Itoplectis in the act of ovipositing on cocoon of apple-tree tent caterpillar. Enlarged. (After Fiske.)

The caterpillars are also subject to destruction by a bacterial disease, especially when they become grown or nearly so, and sick, sluggish individuals may often be observed lying outside at full length on the nest. Larvæ killed by this disease are soft-bodied, the skin easily rupturing and permitting the escape of the liquid, decomposed body contents.

METHODS OF CONTROL.

REMOVAL OF USELESS TREES.

As has been stated, the unsightly nests of the tent caterpillars are especially apt to be found on wild cherry, apple, and other trees growing along roadsides, fences, and elsewhere. In most cases such trees could doubtless be removed without disadvantage, and their removal would greatly reduce the numbers of this pest by lessening their favorite food supply.

COLLECTING THE EGGS.

During the dormant period of trees, when the leaves are off, the egg masses are fairly conspicuous, and with a little practice may be readily found; it is then that the twigs bearing them should be cut off and burned. Trees infested with larvæ during the early part of the year, or those in the immediate vicinity, are perhaps more likely to be chosen by the parent moth for the deposition of her eggs, and such trees at least should be searched if it is not practicable to extend

[1] *Podisus placidus* Uhl., *P. modestus* Dall., and *P. serieventris* Uhl.

the work to the orchard as a whole. This work may be combined with pruning to good advantage, and a lookout should be kept not only for the eggs of this insect but for the eggs and cocoons of other injurious species which pass the winter on the trees.

Practical illustrations of what may be accomplished in collecting the egg masses of this species have recently been reported by Prof. Myron A. Cobb, of the Central State Normal School at Mount Pleasant, Mich. The tent caterpillar was present in unusual numbers in northwestern Michigan during the season of 1913, and egg masses were consequently very much in evidence the following winter (1913–14). Through circulars issued to the rural schools, the school children were interested in the collection of egg masses, with surprisingly successful results. A special "apple-tree tent-caterpillar week" was designated and other means adopted to carry out effectively the campaign against this insect. The total number of egg masses collected through the work of the school children was variously estimated at from one million to several million. A few specific examples may be cited. In Wexford County 250,000 egg masses were reported to have been collected. At Greilickville, 20,443; Bungham School, Grand Traverse County, 17,940. At Elk Rapids the Business Mens' Association offered prizes for the greatest number of egg masses destroyed. This also was done at Old Mission and 65,784 egg masses were collected, the prize going to Carl Ostlind for 11,044 egg masses taken.

Since each egg mass contains on the average some 250 eggs, the benefits from this work may readily be calculated.

There are great possibilities for the accomplishment of much effective work in the control of this and other insect pests by the enlistment of the services of children in rural schools, and the work is a practical application of science for the benefit of agriculture.

DESTROYING THE CATERPILLARS.

Neglect to search out the egg masses during the winter will result in the appearance of the larvæ about the time the trees are putting forth foliage. The nests, at first small, are soon so increased in size as to attract attention. If the caterpillars are destroyed as soon as the small nests are detected, this will prevent further defoliation of the trees, and the rule should be adopted to destroy them promptly as soon as discovered. In this work either of two practices may be adopted, namely, destruction by hand or with a torch.

When in convenient reach, the nests may be torn out with a brush, with gloved hand, or otherwise, and the larvæ crushed on the ground, care being taken to destroy any caterpillars which may have remained on the tree.

The use of a torch to burn out the nests will often be found convenient, especially when these occur in the higher parts of trees. An asbestos torch, such as is advertised by seedsmen, will be satisfactory, or one may be made simply by tying rags to the end of a pole. The asbestos or rags are saturated with kerosene and lighted and the

caterpillars as far as possible cremated. Some caterpillars, however, are likely to escape, falling from the nest upon the application of the torch. In using the torch great care is necessary that no important injury be done the tree; it should not be used in burning out nests except in the smaller branches and twigs, the killing of which would be of no special importance. Nests in the larger limbs should be destroyed by hand, as the use of the torch may kill the bark, resulting in permanent injury.

SPRAYING WITH ARSENICALS.

Tent caterpillars are readily destroyed by arsenicals sprayed on foliage of trees infested by them. Dr. H. T. Fernald's careful experiments and those of Prof. Lowe in determining the amount of poison necessary to kill the caterpillars show that the latter are very sensitive and are killed in from two to three days by the use of Paris green at the rate of 1 pound to 300 or 400 gallons of water.

Orchards or trees sprayed with arsenicals in the spring for the codling moth, cankerworms, or similar insects will be kept practically free from tent caterpillars, and this species rarely requires attention at the hands of the up-to-date commercial fruit grower. It will be troublesome in the scattered trees around the home or in the small orchard which is not regularly sprayed. On such trees the nests will likely be in evidence every spring, and during occasional years the caterpillars may be excessively abundant, completely defoliating the trees.

Even in the small home orchard of a dozen or more trees it will be found highly profitable to adopt a system of spraying which will control not only tent caterpillars but such serious pests as the codling moth, cankerworms, and various bud and leaf feeding insects, and will greatly reduce injury from the curculio.

Any of the arsenical insecticides may be used, as Paris green, Scheele's green, arsenate of lead, etc. The first two are used at the rate of 1 pound to 150 or 200 gallons of water, and the last at the rate of 2 pounds to 50 gallons of water, the milk of lime obtained by slaking 2 or 3 pounds of stone lime being added to neutralize any caustic effect of the arsenical on the foliage. Preferably, however, the poisons should be used in dilute lime-sulphur wash or Bordeaux mixture, thus effecting a combination treatment for insects and fungous diseases. On stone fruits, such as cherry, peach, and plum, arsenicals are likely to cause injury to foliage and must be used with caution. On such trees the arsenate of lead is preferable to the arsenicals, as it is less injurious to foliage, and on all trees sticks much better. In spraying for the tent caterpillar only, applications should be made while the caterpillars are yet small, as these succumb more quickly to poisons than those more nearly full grown, and prompt treatment stops further defoliation of the trees.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 663 JUNE 5, 1915.

Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.

DRUG PLANTS UNDER CULTIVATION.

By W. W. STOCKBERGER,
Physiologist in Charge of Drug-Plant and Poisonous-Plant Investigations.

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INTRODUCTION.

Interest in the possibility of deriving profit from the growing of drug plants is increasing yearly. The clearing of forests, the extension of the areas of land under tillage, and the activities of drug collectors threaten the extermination of a number of valuable native drug plants. Annually, large sums of money are expended for crude drugs imported from countries where they are grown under conditions of soil and climate resembling those of many localities in the United States. As a means of guaranteeing the future supply of crude drugs and of lessening the dependence on importations, attention is now being turned to the cultivation of drug plants with a view to increasing domestic production.

The problems presented by the cultivation of drug plants are not less difficult than those encountered in the production of many other crops. Drug plants are subject to the same diseases and risks as other crops and are similarly affected by variations in soil and climatic conditions. They require a considerable outlay of labor, the

same as other crops, and likewise require intelligent care and handling. They are subject to the same laws of supply and demand, and, like other products, must conform to the consumer's fancy and to definite trade requirements.

A number of common medicinal plants have long been cultivated in gardens in this country, either as ornamentals or as a source of herbs used in cookery and as domestic remedies. A few of these plants, such as goldenseal, wormwood, wormseed, and peppermint, have been grown commercially for sale as crude drugs; but the acreage devoted to their production has been relatively small and for the most part restricted to certain localities. Other drug plants which occur as common weeds in many places may prove to respond to cultivation; experiments should then be undertaken to determine whether it is profitable to grow them. In this connection it should be remembered that the soil type very often is an important limiting factor in propagating different kinds of plants. Some plants grow best in well-drained loam, some prefer a marsh, some require soils rich in lime, while others thrive only in acid soil. The soil requirements of all plants are not understood; in fact, it is not improbable that better comprehension of the soil, climatic, and cultural conditions adapted to the different kinds of plants will enable the successful propagation of species now regarded as unsuited to cultivation. In undertaking the growing of medicinal plants, therefore, it is essential to know that the species selected for cultivation will do well under the conditions of soil and climate existing where the planting is to be made. When necessary, this should be determined on small experimental plats before undertaking commercial plantings.

Assuming that the soil and climate of the situation selected are suitable for the growing of drug plants, it does not necessarily follow that they can be produced at a profit. The cost of production and marketing may be greater than the amount received for the crop when it is sold. Some drug plants not well suited for cultivation on a large scale may be found profitable when grown on small areas as a side line. On the other hand, some may be produced more cheaply when cultivated on a scale large enough to warrant the use of labor-saving devices than when grown on small areas with the aid of hand labor alone. The value of land, the cost and availability of labor, and the possible returns from other crops are all factors to be considered carefully. On account of the variation in these factors according to locality, the same crop might prove to be profitable in one location and unprofitable in another. It is for these reasons that unqualified statements concerning the ease and profitableness of drug-plant growing should not be taken too seriously.

SOME DRUG PLANTS SUITABLE FOR CULTIVATION IN THE UNITED STATES.

The number of drug plants which may be grown in the United States is large, although the same plants are not equally adapted to the conditions of soil and climate prevailing in different sections. Often the most suitable plants for a particular locality can not be foretold, especially in those situations where no attempts have yet been made to grow them. In such cases it is well to select for cultivation plants which thrive elsewhere under conditions most closely resembling those of the new situation in which it is proposed to grow them. The success with which ordinary field or garden crops can be grown will in general indicate the possible suitability of a given location for growing many medicinal plants. Since a number of native medicinal plants which in their wild state are restricted to certain localities have been successfully cultivated in situations far beyond their natural range, there are good reasons for believing that many such plants will thrive in sections where they are not now grown. However, good results can scarcely be expected unless the plants are placed under conditions similar to those in which they normally thrive.

In suitable soil and under favorable weather conditions the following drug plants have been found to thrive well under cultivation in numerous places in the Central and Eastern States and will probably be found suitable for cultivation in many other situations if the difference in climatic conditions is not too great:

Anise.	Catnip.	Echinacea.	Pennyroyal.
Belladonna.	Conium.	Elecampane.	Sage.
Burdock.	Coriander.	Fennel.	Stramonium.
Camomile.	Digitalis.	Henbane.	Tansy.
Caraway.	Dill.	Horehound.	Thyme.

Some perennials, such as belladonna and digitalis, are only partly hardy and would be subject to winterkilling in the colder sections. Such plants as aconite, arnica, lovage, poppy, seneca, valerian, and wormwood seem to thrive best in the northern half of the United States in situations where the rainfall is well distributed throughout the growing season. On the other hand, cannabis, licorice, and wormseed are better suited to the warmer climate of the southern half of the United States. Aletris, althaea, angelica, calamus, orris, pinkroot, peppermint, serpentaria, and spearmint are adapted generally for situations in which the soil is rich and moist, but lavender and larkspur are partial to well-drained sandy soil. Ginseng and goldenseal occur naturally on rich soil in the partial shade of forest trees and can be cultivated successfully only when planted in woodlands or in specially prepared soil under artificial shade (fig. 1).

GENERAL CULTURAL SUGGESTIONS.

The special details of cultivation for each of the medicinal plants mentioned are given under the discussion of the individual species. Suggestions which are of general application, however, are here brought together, in order to avoid unnecessary duplication.

Propagation.—A number of the species considered later can be grown easily from seed, but others are best propagated from cuttings or by division. Many wild medicinal plants are much more difficult to propagate from seeds than the species commonly grown in gardens. Likewise, some of the species now grown abroad and suitable for

FIG. 1.—Lath shed affording partial shade, especially well suited for growing woodland plants.

cultivation in this country are not easily propagated and require special conditions if good results are to be realized.

Seeds of the better known varieties of medicinal plants are regularly listed in the catalogues of numerous seed houses, and those which are less common can usually be obtained from dealers who make a specialty of one or more of these species. Plants can frequently be obtained from nurseries or from dealers in hardy ornamentals. The catalogues of a number of dealers should be consulted and the varieties for propagation carefully selected. In ordering, the medicinal variety should always be called for, since many of the related ornamental forms which are listed are of doubtful, if any, medicinal value.

Sowing the seed.—A relatively small number of medicinal plants can be satisfactorily grown from seed sown in the field. In many cases this method is quite uncertain and with some plants wholly inadvisable. In order to insure a good stand of thrifty plants it is frequently necessary to make the sowings in a greenhouse, hotbed, or cold frame and at a suitable time transplant the seedlings to the field. Much information on seed germination, hotbeds, and cold frames can be gained by consulting Farmers' Bulletins 195 and 255, entitled, respectively, "Annual Flowering Plants" and "The Home Vegetable Garden."[1]

The preparation of the soil is of prime importance, whether the sowing of the seed is made in the open or under cover. Many seeds, especially those which are very small, do not germinate well in heavy soils or in those which are cloddy and coarse in texture. A seed bed prepared by thoroughly mixing equal parts of garden soil, leaf mold, well-rotted manure, and clean sand will be suitable for the germination of most seeds.

The depth of sowing is largely governed by the size of the seeds and the character of the soil. In general, the smaller the seed the less the depth of sowing. Seed should be covered more deeply in light, sandy soil than in heavy clay soil. Fall-sown seeds also require a greater depth of covering than those sown in the spring. The exact quantity of seed which should be used for sowing a given area can not be definitely stated. The same kind of seed will be found to vary widely in its power to germinate; hence, the percentage of germination should be ascertained in advance of sowing and the quantity regulated accordingly. In general, the heavier the soil the larger the quantity of seed required. If the plants are to be thinned out or transplanted, or if they are especially subject to the attacks of insects, the free use of seed is usually advisable.

When plantings are made in open ground it is preferable to sow the seed in rows or drills, in order that cultivation of the soil may be possible. A shallow furrow may be opened with a rake or hand hoe and the seed sown by hand. The rake or hoe may then be used to cover the seed with the required depth of soil. It is much more satisfactory to use seed drills, such as are commonly used by market gardeners, than to sow by hand, since with the drill the depth of sowing is more uniform and the soil is compacted over the seeds, thus favoring good germination. The distance between the rows is determined in part by the size which the plants attain at maturity, but depends chiefly upon the method of cultivation to be used. A spacing of 9 to 16 inches between the rows will readily permit hand

[1] These publications can be obtained free of charge upon application to the Secretary of Agriculture, Washington, D. C.

cultivation, but the rows should be about 3 feet apart if horse-drawn implements are employed.

Cultivation.—There are no set rules for the cultivation of medicinal plants, and the grower's experience with other plants must be relied upon as a guide in many of the details of cultivation. As a general rule, the soil should be worked with the hoe or cultivator at frequent intervals and kept free from weeds. It is a good practice to cultivate after a hard rain as soon as the ground is sufficiently dry. During dry, hot weather loss of moisture from the soil will be diminished by frequent shallow cultivations.

HARVESTING.

Drug roots are usually harvested in the fall or at the end of the growing season of the plant, but they may also be harvested early in the spring while still dormant. Roots collected during the growing season often shrink excessively in drying and so do not form the most desirable product. On small areas either a spade or a potato fork is a suitable tool for digging most roots; but if the area is large, labor will be saved by using a plow to turn out the roots, especially with such crops as belladonna or burdock. Most roots require thorough washing, and when the quantity is large this may be easily done if the roots are placed on a frame covered with wire mesh and water is applied by means of a garden hose.

All roots must be thoroughly dried. Large or fleshy roots are usually split or sliced, spread in thin layers on clean floors, and stirred or turned frequently. Good ventilation is essential, as several weeks usually elapse before the roots are dry enough to be stored with safety. The proper point of dryness is indicated when the roots break readily on being bent. The time of drying may be reduced to a few days by the use of artificial heat. For this purpose the walls of a well-inclosed room are fitted with racks or shelves to receive the roots, or large trays with bottoms made of slats or wire screen are suspended one above the other from the ceiling. The room is heated by a stove, and the temperature maintained between 125° and 150° F. Ventilators must be provided at the top of the room to carry away the moisture which is driven off from the roots. Ordinary fruit driers have been used successfully in drying roots on a small scale, but special drying houses or kilns will be necessary for successfully handling crops grown on an acreage basis.

Leaves and herbs are usually harvested when the plants are in flower. Picking the leaves by hand in the field is a slow process, and time may be saved by cutting the entire plant and stripping the leaves after the plants have been brought in from the field. If the entire herb is wanted, it is preferable to top the plants, for if they are

cut too close to the ground the herb will have to be picked over by hand and all the coarse stems removed. As a rule, leaves and herbs may be dried in the same manner as roots, but almost without exception they are dried without exposure to the sun, in order that the green color may be retained so far as possible.

Some flowers are gathered while scarcely open and others as soon after opening as possible, and in general they should be carefully dried in the shade to prevent discoloration. Hand picking is very laborious, and mechanical devices similar to a cranberry scoop (fig. 2) or seed stripper (fig. 3) may often be used to good advantage. A homemade picker may be constructed as follows: From a stout wooden box, about 10 inches wide, 14 inches long, and 6 inches deep, remove one end and connect the opposite remaining sides at the top with a stout strip, which will serve as a handle. Drive long, slender

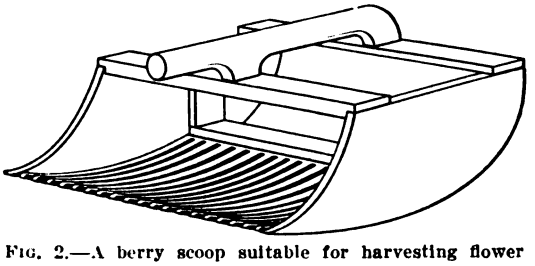

FIG. 2.—A berry scoop suitable for harvesting flower heads of large size.

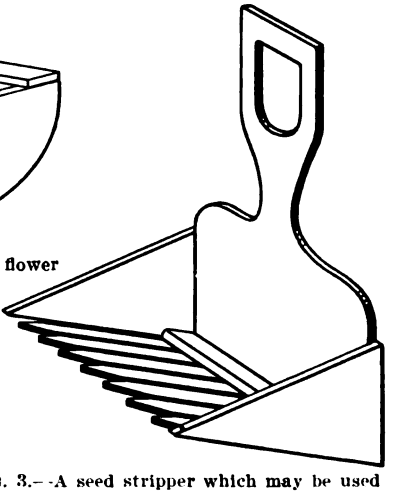

FIG. 3.—A seed stripper which may be used for gathering flower heads.

wire nails through an inch strip of wood at quarter-inch intervals, thus forming a "comb," the teeth of which should be about 2 inches long. This comb is fastened to the bottom of the box in such a manner that the teeth will project outward through the opening left by the removed end. On swinging this device, teeth forward, through the flowers, the heads will be snapped off by the comb and will fall into the box, from which they may be emptied into suitable containers.

Seeds are harvested as soon as most of them have ripened and before the pods or seed capsules have opened. Seedlike fruits, such as anise, coriander, fennel, and wormseed, are harvested a little before they are fully ripe, in order that they may retain a bright, fresh appearance, which adds to their market value. The machinery used for thrashing and cleaning ordinary seed crops will frequently serve a similar purpose for seeds of medicinal plants, provided the proper adjustments have been made. Most seeds must be spread out to dry

and turned at intervals until thoroughly dried before they can be stored in quantity.

DISTILLATION.

The volatile oil obtained from many aromatic plants by steam distillation is often their most valuable product. The equipment necessary for distilling volatile oils consists essentially of a steam boiler, a retort, and a condenser. A constant supply of cold water must also be available. A common type of retort consists of a circular wooden vat, about 6 feet in diameter and 8 to 10 feet deep (fig. 4), fitted with a removable cover, which can be made steam tight. Metal retorts made of boiler iron three-sixteenths of an inch thick and jacketed with wood to prevent the radiation of heat are also used. A pipe leads from

FIG. 4.—A still used in the production of wormwood oil.

the steam boiler to the bottom of the retort and another from the top of the retort to the condenser, one form of which consists of a coil of tin-lined or galvanized-iron pipe inclosed in a jacket through which cold water is kept flowing when the still is in operation.

When the retort is filled with aromatic plants and steam is admitted through the pipe from the boiler, the volatile oil is extracted in the form of a vapor, which is carried over with the steam to the condenser, where both are condensed to liquid form. The oil and water together flow from the condenser into the receiver, one type of which is constructed like an ordinary milk can and is fitted with a siphon

leading from the bottom, through which the water is drawn off to prevent the receiver from overflowing.

Many volatile oils will float on the water and may be drawn off from the top of the receiver at will. Other oils, such as sassafras and wintergreen, are heavier than water, and should be collected in a receiver provided at the bottom with an outlet tap through which the oil may be drawn off.

The cost of setting up a still will depend upon what facilities are already at hand and upon the size and efficiency of the apparatus installed. It may easily range from a small sum to several thousand dollars.

YIELD.

The yield that can be obtained from drug plants in different localities will naturally vary according to the suitability of the situation for the plants selected for cultivation. Even in the same locality wide variations in yield will result from differences in the lay of the land and in soil, drainage, and seasonal conditions. The skill of the grower and the degree of care and attention which he bestows upon his crop are also factors affecting yield.

Many of the drug plants mentioned in this bulletin have not been grown on a scale large enough to give a very satisfactory basis for calculating yields. Acreage yields calculated from the product of small garden plats are generally untrustworthy, since in such plats the plants are usually more favorably situated with respect to soil and are given better culture than when under field conditions. Moreover, as the area increases, it becomes more difficult to maintain an approximately perfect stand and to protect the crop from the ravages of insects or other destructive agencies. The returns from small experimental areas can at most be regarded as only an indication of the yield that may be expected under favorable conditions, and the prospective grower will do well to proceed cautiously until he has determined for himself the possibilities of yield in his particular location.

MARKETING.

The commercial grower of drug plants can not give too much attention to the problem of securing a satisfactory market for his product. Growers who live near the cities in which dealers in crude drugs are located or in sections where wild medicinal plants are collected may be able to find a local market, but in many situations the local marketing of crude drugs in quantity will not be possible. In such cases the grower should send samples of his product to dealers in crude drugs or to manufacturers of pharmaceutical preparations and request them to name a price at which they would purchase his

crop. The material for the samples should not be specially selected or so prepared as to represent a quality higher than that of the whole lot, since this would give the purchaser just cause for making a reduction in price on delivery or for rejecting the whole shipment. It is well to send samples to a number of dealers, since their prices will be found to vary with the stock on hand and trade prospects. Before selling, the state of the wholesale drug market should be learned. The prices to producers are, of course, always lower than the wholesale price; nevertheless, the grower who is informed in respect to the wholesale market will be in a position to judge of the fairness of the prices offered for his crop by dealers.

Under special conditions some crude drugs can be sold at a material advance over the prevailing market price. By always supplying a well-prepared, carefully selected drug of high quality some growers have built up a trade in their particular product for which they secure extra-good prices. Dealers and manufacturers also sometimes make contracts with reliable growers to take the entire crop of a particular drug, thus insuring to the grower a definite market and good prices for the product.

COMMERCIAL PROSPECTS.

However desirable it may be to increase the available supply of crude drugs or to diminish the amount of money now sent to foreign countries for these products, the most important consideration for the American farmer who would grow drug plants is the probable profit to be derived from such an enterprise. Many statements to the contrary notwithstanding, the commercial production of crude drugs does not normally present unusual opportunities for quick returns and large profits. Knowledge respecting the cultivation and handling of medicinal-plant crops is far less widespread than in the case of such generally distributed crops as fruits, vegetables, and cereals, and certain individuals have taken advantage of this lack of information to lead the public to believe that extraordinary profits may be realized from growing medicinal plants, even in a situation no more promising than the average city back yard. Such persons are interested usually only in the sale of the plants and seeds for propagation or the questionable directions for their cultivation, and the extravagant claims often set forth in their alluring advertisements are not only misleading, but frequently have little basis in fact.

The market demand for any given crude drug is naturally a large factor in determining the prospects for its commercial production under cultivation. The demand for a number of drugs is quite variable or exceedingly limited, and hence insufficient to make it advisable to raise them on a large scale. In the case of other drugs,

although the demand is fairly constant and steady, it could probably be fully satisfied by the product of a very few acres of good land. It is evident that the cultivation of any considerable acreage might easily result in overproduction, with a consequent decline in market price to a point where production would not be profitable.

The cultivation of drug plants, to be successful in this country, will probably require the introduction of improved methods and the extensive use of machinery to replace hand labor so far as possible. Growers of mints and numerous other plants yielding essential oils will find it desirable to equip themselves with a suitable distilling plant, although the latter can not be operated most economically when only a small quantity of material is available for distillation. The natural tendency will be to increase the acreage in the interest of more efficient operation, but here again there is danger of overproduction, and prospective growers should thoroughly acquaint themselves with market conditions before bringing very large areas under cultivation.

Very few, if any, drug plants are used in quantities sufficient to make them a promising crop for general cultivation. Many of the common ones, which can be grown and prepared for market with little difficulty, bring but a few cents a pound, and their cultivation offers little prospect of profit. A number of the high-priced drug plants must be given care for two or more years before a crop can be harvested, and, since expensive equipment is usually required for their successful culture, the production of such crops offers little encouragement to inexperienced growers who are looking for quick returns and large profits from a small investment. The production of drugs of high quality requires skilled management, experience in special methods of plant culture, acquaintance with trade requirements, and a knowledge of the influence of time of collection and manner of preparation on the constituents of the drug which determine its value. Small quantities of drugs produced without regard to these conditions are apt to be poor in quality and so unattractive to dealers and manufacturers that the products will not be salable at a price sufficient to make their production profitable. In general, the conditions in this country seem far more favorable to the growing of drug plants as a special industry for well-equipped cultivators than as a side crop for general farmers or those whose chief interest lies in the production of other crops.

Although a number of plants which yield products used as crude drugs are common farm weeds, they usually occur in scattered situations and in such small quantities that their collection would scarcely prove profitable for the farmer. Even when relatively abundant it is a matter for careful consideration whether the time and labor necessary for their collection might not be otherwise

employed to better advantage. Moreover, it is not always easy to distinguish medicinal plants from others of similar appearance, and collectors not infrequently find that they have spent their time in gathering plants practically worthless as crude drugs. In proportion to the labor required in their collection, relatively low prices are paid for most crude drugs obtained from wild plants, and the farmer who turns to drug collecting as a source of additional revenue will probably meet with disappointment.

THE CULTIVATION AND HANDLING OF DRUG PLANTS.

The following cultural directions and suggestions regarding the handling of a number of drug plants have been compiled in part from the records of the Office of Drug-Plant and Poisonous-Plant Investigations and include data secured by Dr. W. Van Fleet, S. C. Hood, G. A. Russell, T. B. Young, and various other members of the staff of that office connected with testing gardens in several widely separated localities. The probable yields per acre are in many cases estimates calculated from smaller areas, and considerable variation from the figures given must be expected in actual practice. The prices mentioned are given merely to indicate the comparative value of the products concerned and not to fix the actual price which the grower of drug plants may expect to receive. This will depend very largely upon the state of the market at the time the crop is offered for sale.

The plants mentioned in the following pages were selected for discussion because information regarding their cultivation is in constant demand. The purpose of this bulletin is not to recommend these plants for cultivation, but to give information concerning their culture which may be helpful to persons who are considering the production of drug plants on a commercial scale.[1]

ACONITE.

Aconite (*Aconitum napellus*) is a hardy perennial, introduced from Europe and sparingly grown in this country as an ornamental garden plant. Both leaves and roots are very poisonous, the latter forming the official drug. Other varieties than *Aconitum napellus* are also grown in flower gardens, and several species occur wild in the United States. Since the official species readily hybridizes with related varieties, often to the detriment of its medicinal properties, it is frequently difficult to secure seed which will come true to name.

Aconite seems to thrive best in a rather cool climate and will grow in any rich garden soil, but a well-drained gravelly loam in an elevated situation appears most suited for the cultivation of this plant. It may be grown from seed sown in the open late in the fall or early in the spring, or plants may be started in a seed bed and the seedlings later transplanted and set about a foot apart in rows 2 feet apart. The preferable method of propagation is by division of the roots after the stems have died down in the fall, since thereby hybridization may be avoided.

[1] For information in regard to weeds used as medicine not herein considered, see Farmers' Bulletin 188, which may be obtained free of charge upon application to the Secretary of Agriculture.

The plants usually flower in the second year from seed, when the roots may be harvested. It is preferable, however, to defer harvesting until the stems have died down in the fall. After the roots are dug they are washed, split, and dried, to form the commercial drug. The leaves also are harvested, but are not in much demand.

Reliable data on yield are not available, although some estimates place the yield at about 450 pounds of dry root per acre. The American market is supplied with imported aconite root, for which the wholesale price normally ranges from about 9 to 15 cents a pound. The quantity imported in 1913 was about 13,000 pounds. The demand for this drug is limited, and this fact, together with the probable low yield, makes its profitable cultivation in this country very doubtful.

ALETRIS.

Aletris, star-grass, or true unicorn root (*Aletris farinosa*, fig. 5) is a native perennial herb of the lily family, found occasionally on sandy soil throughout the eastern half of the United States; also frequently occurring in the pine and oak barrens of Alabama and Tennessee and elsewhere in the South. The root is used medicinally.

Aletris is a slow-growing plant which seems to thrive best on a moist and sandy soil. It may be propagated either by division of the root stocks or from seeds. The seeds mature late in the summer, and should be sown soon after ripening, in a well-prepared and protected seed bed. In the following spring the seedlings may be transplanted to their permanent situation and set about a foot apart in rows 20 inches or more apart. The soil about the plants should be stirred frequently and kept free from weeds.

The root, consisting of a short horizontal rootstock bearing numerous small rootlets, may be harvested in the fall of the second or third year. In preparing the root for market the stem and leaves are broken off and the dirt is removed by shaking (or washing, if necessary), after which it is well dried. There are no available data on the probable yield. The prices paid for Aletris usually range from 12 to 25 cents a pound.

FIG. 5.—Aletris (*Aletris farinosa*).

ALTHAEA.

Althaea, or marshmallow (*Althaea officinalis*), is a perennial herb introduced from Europe which now grows wild in marshy places near the sea in Massachusetts and along tidal rivers in New York and Pennsylvania. The root forms the official drug, but the leaves and flowers also are sometimes used medicinally.

Althaea will grow well in almost any loose garden soil of moderate fertility, but tends to winterkill in situations where the ground freezes to a considerable depth. The plants may be propagated from seeds or from divisions of the old roots made early in the spring. The seed may be sown in the open in shallow drills at least 3 feet apart, and the seedlings should be thinned to stand 16 inches apart in the row. Under good conditions the plants attain a height of 3 or 4 feet; therefore, close planting does not give sufficient room for full development.

In the second year of growth the roots are harvested, washed, peeled, cut into short lengths, and thoroughly dried. Yields at the rate of 800 to 1,000 pounds of dry root per acre have been obtained. The wholesale price usually ranges from 12 to 20 cents a pound. In view of the amount of hand labor required in preparing the root, the relatively low price, and the rather limited demand, the cultivation of this plant for profit is not very attractive.

ANGELICA.

Angelica (*Angelica officinalis*) is a European biennial plant of the parsley family, sometimes grown in this country as a culinary herb and known commonly as garden angelica. The fresh stems and leafstalks are used as a garnish and for making a candied confection. The seeds and the oil distilled from them are employed in flavoring, and the aromatic roots are sometimes used in medicine.

Angelica thrives best in a moderately cool climate and may be grown in any good soil, although a deep, fairly rich loam which is moist but well drained will give the best results. The soil should be deeply plowed and well prepared before planting. The plant is most readily propagated from divisions of old roots, which may be set either in the fall or spring about 18 inches apart in rows. The seeds germinate very poorly if more than one year old, and it is best to sow them as soon as they are ripe in a seed bed, which should be kept moist by frequent watering if necessary. Early in the following spring the seedlings are transplanted and set about 2 feet apart each way in their permanent location. Plants may also be obtained from seeds sown in March in a spent hotbed or in a cold frame. In order to increase the root development, the plants are often transplanted a second time, at the end of the first year's growth, and set 3 or 4 feet apart. For the same reason the tops are often cut back to prevent the formation of seed. During the growing seasons the soil should be kept mellow and free from weeds by frequent cultivation.

The roots are usually harvested in the fall of the second year, but sometimes those of the first-year plants are marketed. After being dug, the roots are washed and dried in the open air. In order to keep out insects and to preserve the aroma it is best to store the dried root in tin containers which can be tightly closed. The root of the European or garden angelica found in our drug markets is imported largely from Germany. During the past few years the wholesale price has averaged about 20 cents a pound.

The root of a native species of angelica (*Angelica atropurpurea*), commonly called American angelica, also occurs in the drug markets of this country. It is collected from wild plants and usually brings from 6 to 10 cents a pound.

ANISE.

Anise (*Pimpinella anisum*) is an annual herb of the parsley family, widely cultivated in Europe and to a limited extent in this country, chiefly in Rhode Island. Although this plant may be grown quite generally throughout the United States, it has been found difficult to bring the crop to maturity in northerly situations where the growing season is short or in the South where the climate is hot and dry. It is grown chiefly for its aromatic seeds (fruits), which are used medicinally and also in baking and for flavoring confectionery. The oil distilled from the seeds is used medicinally in cordials and also for flavoring various beverages.

Anise thrives best in a light, moderately rich, and well-drained loam which has been carefully prepared before planting. It is grown from seeds, which are usually sown early in the spring directly in the field, since the seedlings are unfavorably affected by transplanting. The seeds, which should not be more than 2 years old, are sown thickly, about two to the inch, and covered one-half inch deep. Since the plants develop very slowly, seed should not be sown in weedy soil. When the seedlings are 2 to 3 inches high they are thinned to stand 6 inches apart in the row. The rows may be 18 inches or 3 feet apart, depending on the cultivation intended. An ounce of seed should sow a row 150 feet long, and about 5 pounds will plant an acre when the rows are 3 feet apart. The plants should receive frequent and thorough cultivation throughout the growing season.

About three months from the time of planting the plants will blossom, and a month later the seed should be matured sufficiently for harvesting. As soon as the tips of the seeds turn a grayish green color they should be harvested, for if allowed to remain exposed to the weather they quickly turn brown or blacken. The plants may be pulled by hand and stacked, tops inward, in heaps about 6 feet high, or they may be mowed and at once built up into cocks of the same height. In about four or five days the seed will have ripened, after which it should be thrashed out and thoroughly cleaned.

Yields of anise seed are quite variable, since the plant is very sensitive to unfavorable weather conditions. In a good season from 400 to 600 pounds per

acre may be reasonably expected. The price usually ranges from 6 to 8 cents a pound. On the average about 500 tons are annually imported into this country.

ARNICA.

Arnica (*Arnica montana*) is a herbaceous perennial plant of the aster family, native in northern and central Europe, where it thrives in the cool climate of the mountain meadows and upland moors. The flowers, leaves, and roots are employed in medicine.

Arnica requires a marshy soil, abundant rainfall, and a cool climate for its best development. It is propagated by divisions of the roots or from seeds sown either in the fall or the spring. Seed may also be sown in August in a seed bed and the plants transplanted the following spring to stand about 18 inches apart in the row. The flowers may be harvested the second year and the roots after three or four years.

Arnica is not produced commercially in the United States, and the small quantity imported annually is apparently sufficient to meet the market demands. Its cultivation presents many difficulties, and efforts to grow it in the milder portions of this country have generally proved unsuccessful.

BELLADONNA.

Belladonna, or deadly nightshade (*Atropa belladonna*), is a large, poisonous perennial which occurs wild in Europe, where it is also cultivated. Both the leaves and the roots are important crude drugs. In recent years it has been cultivated to some extent in this country, but is likely to winterkill in the colder sections.

Belladonna may be propagated in a small way from cuttings of the young shoots rooted in moist sand in the usual manner or from divisions of the fleshy rootstocks made early in the spring, but it is most readily grown from seeds which may be thinly sown in pots or well-drained boxes in a cool greenhouse in midwinter or in a sheltered place in a garden early in the spring. When the seedlings are large enough to handle they should be transplanted singly to small pots or pricked out in flats or shallow boxes of light, rich soil, placing them about 2 inches apart each way, as with tomato or other vegetable plants intended for field planting. In the spring, as soon as danger from frost is over, they should be transplanted to the field and set about 20 inches apart in rows 30 or more inches apart. Sowing seeds in the field or transplanting directly from the seed bed to the field has rarely given good results in this country. Belladonna seeds are small, and if well handled under glass or in protected seed beds 1 ounce should produce 10,000 or more plants, sufficient to set an acre.

Belladonna thrives best in deep, moist, well-drained loam containing lime, such as will under proper fertilization produce good garden vegetables. The preparation of the soil should be very thorough and consists of deep plowing, either in the fall or early spring, and repeated working with the disk or spring-tooth and smoothing harrows. Weeds should be kept under control at all times and the soil stirred with a hoe or cultivator at intervals of about 10 days, particularly after each hard rain, and shallow cultivation given in hot, dry weather to conserve the natural moisture of the soil. Good commercial fertilizers, such as are commonly used in truck gardens, are beneficial. Those containing 8 per cent of phosphoric acid, 4 per cent of nitrogen, and 4 per cent of potash are the most desirable and should be applied at the rate of about 600 pounds per acre. Stable manure at the rate of 12 to 20 tons to the acre may be used if plowed under when the ground is prepared.

Belladonna is sometimes affected by a wilt disease, which is aggravated by wet soils and fresh animal manures, and the foliage is greedily attacked by the potato beetle. Dusting with lime, soot, or road dust in the morning when the leaves are wet with dew is occasionally effective. The destructive attacks of these pests are usually confined to the seed bed or to first-year plantings, but the insects may be controlled by the careful use of insecticides.

The leaves are picked when the plants are in full bloom. They should be carefully handled, to avoid bruising, and dried in the shade in order to retain their green color. A hundred pounds of fresh leaves yield about 18 pounds when well dried. One crop only can be collected the year of planting, but two crops are gathered in each of the next two or three years, after which it appears better to market the roots and make new plantings. While only the leaves should be collected for the best pharmaceutical trade, the young growth,

including the smaller sappy twigs, has medicinal value and may be sheared from the plants and dried in the same manner as the leaves. The ease of collection and increased weight of material may render the latter method more profitable.

The roots are considered fully as profitable as the leaves. The best roots are those of the second and third years' growth. They are harvested in the fall after frost, the tops being mowed and raked off and the roots turned out with a deep-running plow, or with a potato fork if the area be small. They are carefully washed and cut into about 4-inch lengths, the larger pieces being split lengthwise to aid in drying. Thorough drying either in the sun or with mild artificial heat is essential; otherwise, the roots will mold when stored.

On experimental areas near Washington, D. C., under rather unfavorable soil conditions, yields at the rate of 300 to 400 pounds of dried leaves per acre were obtained. When both leaves and tops are included, these figures should be somewhat increased. The dried root harvested at the end of the second year averaged 1,100 pounds per acre. For some years past the range of prices, as quoted in the wholesale drug markets, has been from 14 to 25 cents a pound for the leaves and from 9 to 18 cents a pound for the root. Prices to growers have, of course, been proportionately less.

BLUE FLAG.

Blue flag (*Iris versicolor*) is a native perennial plant of common occurrence in swamps and marshy situations throughout the eastern half of the United States. The underground stem (rhizome) and roots are the parts of the plant used medicinally.

Blue flag responds readily to cultivation when placed in a rich, moist, and rather heavy soil. It is readily propagated from divisions of old plants, which may be set 1 foot apart in rows spaced conveniently for cultivation. If the plants are set in August or September, the crop may be harvested about the last of October in the following year. The roots may be turned out with a deep-running plow, and after being thoroughly washed and the larger clusters broken up they should be thoroughly dried. Artificial drying at low heat is usually desirable.

Yields at the rate of 3 or 4 tons of dried root per acre have been obtained from small plats. The price paid to collectors varies from year to year, usually ranging from 5 to 10 cents a pound. This crop does not appear to be very promising, owing to the relatively small demand for the root.

BONESET.

Boneset (*Eupatorium perfoliatum*) is a hardy, rather long-lived perennial plant commonly found growing in low grounds throughout the eastern half of the United States. The dried leaves and flowering tops form the official drug.

Divisions of clumps of wild plants collected early in the fall will serve for propagation. These may be set about a foot apart in rows in well-prepared soil. During the first winter the newly set divisions should be protected with a light mulch of straw or manure. Plants may also be grown from seeds, which should be collected as soon as ripe and sown in shallow drills about 8 inches apart in a rich, moist seed bed, preferably in partial shade. When of sufficient size they may be set in the field at about the same distance as the divided clumps.

The plants are cut late in the summer when in full bloom and the leaves and flowering tops stripped from the stem by hand and carefully dried without exposure to the sun. Yields of well-cultivated boneset are quite large and 2,000 pounds or more per acre of dry herb may be obtained under favorable conditions. The price for boneset is low, rarely exceeding 2 or 3 cents a pound. Since the demand is limited and the wild supply fairly available, the cultivation of boneset does not offer much prospect of profit.

BURDOCK.

Burdock (*Arctium lappa*) is a large biennial plant well known as a common and troublesome weed in the Eastern and Central States and in some western localities. The dried root from plants of the first year's growth forms the official drug, but the seeds and leaves are also used medicinally.

Burdock will grow in almost any soil, but the best root development is favored by a light well-drained soil rich in humus. The seeds germinate readily and may be sown directly in the field, either late in the fall or early in the spring. The seed may be sown in drills 18 inches or 3 feet apart, as desired, and should be sown 1 inch deep if in the fall, but less deeply if sown in the spring. When the seedlings are well up they should be thinned to stand about 6 inches apart in the row. Cultivation should continue as long as the size of the plants will permit.

The roots are harvested at the end of the first year's growth in order to secure the most acceptable drug and also to prevent the plants from bearing seed and spreading as a weed. The tops of the plants may be cut with a mower and raked off, after which the roots can usually be turned out with a deep-running plow or with a beet lifter. In a dry and very sandy soil the roots frequently extend to a depth of 2 or 3 feet, making it necessary to dig them by hand. After digging, any remaining tops are removed and the roots are washed and dried, the drying being preferably by the use of low artificial heat. The roots are usually split lengthwise into two or more pieces in order to facilitate drying, although whole roots are marketable.

Yields at the rate of 1,500 to 2,000 pounds of dry roots per acre have been obtained. The prices offered by dealers range from 4 to 6 cents a pound.

CALAMUS.

Calamus, or sweet flag (*Acorus calamus*), is a native perennial plant, occurring frequently along streams and in the edges of swamps throughout the eastern half of the United States. The dried root (rhizome or rootstock) is the part used as a drug.

Although calamus in a wild state is usually found growing in water, it may be cultivated in almost any good soil which is fairly moist. It usually does well on moderately dry upland soils which will produce fair crops of corn or potatoes. The plants are readily propagated from divisions of old roots, which should be set early in the fall 1 foot apart in rows and well covered. During the following growing season the plants should receive frequent and thorough cultivation.

The roots are harvested in the fall and may be readily dug with a spade or turned out with a plow. The tops, together with about an inch of the rootstock, are next cut off and used to make new plantings. The roots are washed and dried artificially at a moderately low degree of heat. The marketable product consists of the thick rootstocks deprived of their small rootlets, often called "fibers." These may be removed before drying, but more easily afterwards, since when dry and brittle they break off readily with a little handling. Roots thus treated are often called "stripped" and are more aromatic than those which have been peeled.

Yields at the rate of 2,000 pounds of dry roots per acre have been obtained. The price for the unpeeled root has ranged for the past few years from 3 to 5 cents a pound. About 5 or 6 tons of calamus root were imported in 1913.

CALENDULA.

Calendula, or pot marigold (*Calendula officinalis*), is a hardy annual plant native to southern Europe, but frequently grown in flower gardens in this country. The dried flower heads are sometimes used in soups and stews, and the so-called petals (ligulate florets) are employed in medicine.

Calendula grows well on a variety of soils, but a moderately rich garden loam will give the best results. The seed may be sown in open ground early in the spring in drills 18 inches apart. As soon as the seedlings are well established they should be thinned to stand about a foot apart in the row. In the North it is desirable to sow the seed about the first of April in cold frames or spent hotbeds and transplant the young seedlings as soon as the danger of frost is past.

The plants blossom early and continue to bloom throughout the summer. The flowers are gathered at intervals of a few days and carefully dried. The petals (florets) which form the drug may be removed either before or after the flower heads are dried. The petals are removed by hand, but this process requires so much time that when the cost of the necessary labor is taken into account it is doubtful whether the price received for the drug would cover the cost of production.

The dried flowers produced in this country usually bring from 5 to 8 cents a pound; the petals alone, from 20 to 25 cents a pound. During the past few years the wholesale price for imported calendula has ranged from 30 to 80 cents a pound.

CAMOMILE, GERMAN.

German camomile (*Matricaria chamomilla*) is a European annual herb of the aster family, cultivated in this country in gardens, from which it has escaped in some localities. The dried flower heads are used in medicine.

This species of camomile does well on moderately heavy soil which is rich in humus and rather moist. Since the plants bloom about eight weeks after sowing the seed, a crop of camomile may be grown from seed sown either early in the spring or late in the summer, following early vegetable crops. The seed may be sown in drills and barely covered or may be broadcast, since the plants will soon occupy the ground and exclude the weeds. When the plants are in full bloom the flower heads are gathered and may be spread thinly on canvas sheets and dried in the sun. All leaves and stems should be removed, and when the flowers are thoroughly dry they should be packed for market in boxes or bales rather than in bags, since in the latter the flowers are likely to be badly broken in handling.

Returns from experimental areas indicate that a yield of about 400 pounds of dry flowers per acre may be expected under favorable conditions. Wholesale prices usually range from about 15 to 40 cents a pound.

CAMOMILE, ROMAN.

Roman camomile (also called English camomile, *Anthemis nobilis*) is a European perennial herb of the aster family, frequently cultivated in gardens in this country and sometimes found growing wild. In America, camomile is grown chiefly as an ornamental plant, especially for use in borders, since the plants blossom from midsummer until killed by frost. The dried flower heads from cultivated plants are used in medicine.

Camomile grows well in almost any good, rather dry soil which has full exposure to the sun. The plants may be grown from seeds or propagated by dividing the roots early in the spring. The divisions of the root may be planted 9 inches apart in rows spaced according to the method of cultivation to be used. When planted on a small scale the divisions, or offsets, may be set 9 inches apart each way in carefully prepared soil. Hand weeding is necessary, but since the plants soon spread and fully shade the ground, weeds usually have small chance of becoming troublesome.

The flower heads are gathered just as they open, either by hand or by means of a flower picker, and are dried in the open in bright weather or, when necessary, on canvas trays in a heated room. Rapid drying is essential, as it is desirable to retain the white color as far as possible.

The yield is variable, but from 400 to 600 pounds of dried flowers per acre may be expected. The prices for Roman camomile quoted in the wholesale drug markets of this country usually range from about 10 to 25 cents a pound. Since this crop requires much hand labor, its cultivation on a commercial scale does not promise to be very profitable in this country.

CAMPHOR.

The camphor tree (*Camphora officinalis*) is a large evergreen, native to Asia, and for many years has been grown as an ornamental in the southern and southwestern United States. It is hardy in situations where the winter temperature does not fall below 15° F., and it is now cultivated in Florida on a commercial scale as a source of camphor gum.

This tree can be grown in almost any soil, but the maximum growth is secured in soils which are rich and well drained. When the trees are planted for commercial cultivation new land is preferred. Propagation is easily effected from the seeds. These ripen about the middle of October and should be planted in a seed bed while fresh, without removing the pulp which incloses them. The land for the seed bed should be plowed about the first of September and well worked with a disk harrow. Just before planting it should again be worked over and

all roots of grasses or weeds removed. The seeds are planted 2 or 3 inches apart in rows just far enough apart to permit cultivation with a wheel hoe and are covered 2 inches deep. The plants begin to come up in about three months, but four or five months are often required for a full stand. As soon as the plants can be distinguished in the rows, cultivation should begin, and when they are well up they should receive a good application of high-grade fertilizer.

The plants are allowed to grow in the seed bed for two years, and are then transplated to the field. Previous to transplanting, the land is well prepared by deep plowing and thorough working, and rows are laid off in checks 6 by 15 feet. The transplanting is done early in the winter, but before the trees are set they are well headed back, the leaves and small twigs being removed and the taproot cut back to about 16 inches in length. Water should be applied when the trees are set, and later also if the rainfall is scanty. Cultivation begins early in the spring and should be thorough and frequent until June or July of each year.

In three or four years after transplanting, the trees should be from 7 to 8 feet high. They are then trimmed by means of a modified mowing machine to form an A-shaped hedge, and the cuttings are distilled for the oil and camphor gum. The cuttings are brought from the field to the distilling plant, run through an ensilage cutter, and packed in large metal retorts to which steam under high pressure is admitted at the bottom. The outlet pipe of the retort is connected with a specially constructed condensing apparatus, in which the oil and camphor carried over by the steam are collected. As received from the condenser, the camphor is a very crude product and must be refined before it can be marketed.

The annual yield of cuttings per acre has been estimated at 5 tons, which should give from 125 to 150 pounds per acre of marketable camphor. At present the planting of small areas of camphor does not seem advisable, in view of the heavy outlay required for the necessary distilling and refining plant. An area of 500 acres would probably warrant the installation of the machinery necessary for the commercial production of camphor.

CANNABIS.

The drug cannabis or Indian hemp (*Cannabis sativa*), consists of the dried flowering tops of the female plants. It grows well over a considerable portion of the United States, but the production of the active principle of this plant is believed to be favored by a warm climate. For drug purposes, therefore, this crop appears to be adapted to the Southern rather than to the Northern States.

Cannabis is propagated from seeds, which should be planted in the spring as soon as conditions are suitable, in well-prepared sandy or clayey loam at a depth of about an inch in rows 5 or 6 feet apart. The seeds may be dropped every 2 or 3 inches in the row or planted in hills about a foot apart in the row, 6 to 10 seeds being dropped into each hill. Two or three pounds of seed per acre should give a good stand. About half the seeds will produce male plants, which must be removed before their flowers mature; otherwise, the female plants will set seed, thereby diminishing their value as a drug. The male plants can be recognized with certainty only by the presence of stamens in their flowers.

Ordinary stable or barnyard manure plowed in deeply is better for use as a fertilizer than commercial preparations and may be safely applied at the rate of 20 tons per acre. However, good results may be obtained with commercial fertilizers, such as are used for truck crops and potatoes, when cultivated in between the rows at the rate of 500 or 600 pounds per acre.

When the female plants reach maturity, a sticky resin forms on the heavy, compact flower clusters, and harvesting may then be begun. The tops of the plants comprising the flower clusters are cut and carefully dried in the shade to preserve the green color as far as possible. Drying can best be done, especially in damp weather, by the use of artificial heat, not to exceed 140° F.

Returns from experimental areas indicate that yields of 400 to 500 pounds of dried tops per acre may be expected under good conditions. Although some American-grown cannabis is found in the crude-drug trade, a definite market for this product is not yet established. Those who contemplate the commercial production of this crop should therefore carefully investigate market possibilities before making any extensive plantings.

CARAWAY.

Caraway (*Carum carvi*) is a European biennial herb of the parsley family. It grows and fruits well over a considerable portion of the United States, especially in the North and Northwest, but its cultivation in this country seems never to have assumed commercial proportions. The seeds are used medicinally, but are mainly utilized for flavoring cakes, confectionery, and similar products. On distillation with steam, the seeds yield an aromatic oil, which is more used in medicine than the seed itself.

Soil of a somewhat clayey nature and containing a fair proportion of humus and available plant food is particularly suited to caraway, but the plant generally grows well in any good upland soil which will produce fair crops of corn or potatoes. Seeds should be sown in early spring in drills about 16 inches apart, and from 6 to 8 pounds of seed are sown to the acre. Frequent shallow cultivation throughout both growing seasons is desirable in order to keep the soil mellow and free from weeds, as a weedy crop at harvest time usually means a product inferior in quality.

As soon as the oldest seeds ripen, which is usually in June of the second year, the crop should be harvested. The plants may be cut with a mower and should be left in the swath until they have lost most of their moisture, when they may be built up into small cocks, or they may be brought in from the field and the curing finished in a barn loft. If on handling in the field the seeds shatter extensively, the crop should be brought in in tight wagons. When drying is finished the seeds are thrashed out, cleaned, and stored in bags which contain about 100 pounds each.

Returns from experimental areas indicate that a yield of about 1,000 pounds of seed per acre may be expected. One hundred pounds of seed will usually yield 4 to 6 pounds of oil. The average annual importation of caraway seed is about 2,700,000 pounds, valued at about 6½ cents a pound. About 30,000 pounds of oil, valued at approximately 80 cents a pound, are imported each year.

CASCARA SAGRADA.

Cascara, or cascara sagrada (*Rhamnus purshiana*), is a small tree 20 to 30 feet high, native to the western part of the United States, and found most abundantly in a narrow belt along the Pacific slope from northern California to southern British Columbia. The bark from the trunk and branches is the source of the drug, for which there is a constant and steady demand.

Plantings which have been made in the Eastern States indicate that this tree may probably be grown along the Atlantic slope in the Piedmont or foothill belt from Pennsylvania to Georgia. The trees have been found to grow better in clay loam than in either sand or clay. Propagation from seed is easy, but the seeds should be planted in the fall soon after they ripen or stratified in sand until used, since germination is very poor if the seeds are allowed to become dry. The seeds are sown in a seed bed under shade in drills 8 inches apart and covered about 1 inch deep. The seedlings reach a height of 10 to 15 inches the first year, and in the following spring before the leaves appear they are set in the field 6 feet apart each way. It is advisable to cultivate frequently, in order to keep the weeds down and to maintain a shallow surface mulch.

If the trees are pruned properly, a crop of bark may be harvested each year without killing the whole tree, as is done in collecting the bark from wild trees. At the time of transplanting, the trees are cut back to a straight stem about a foot high, from which all except the four uppermost buds are removed. The branches which afterwards develop from these buds are later deprived of their lower side shoots, thus causing the tree to grow a head of four long, stout branches instead of a single straight trunk. When the trees are large enough to yield a crop of bark, the longest of the four branches is cut off early in the spring flush with the trunk and a new branch is allowed to grow in its place. This process may be repeated yearly, removing only the largest branches of each tree in any one season.

The bark on the cut-off branches is divided with a sharp knife into lengthwise strips of about an inch or two in width, which may be readily pulled off. It is then dried carefully at a low temperature in the shade and broken into small pieces to facilitate packing and handling.

The price paid to collectors for cascara bark usually varies from 1 to 4 cents a pound, and so long as a supply of the wild bark continues to be available it is doubtful whether cascara can be cultivated at a profit.

CATNIP.

Catnip (*Nepeta cataria*) is a European perennial plant of the mint family, which frequently occurs in this country as a weed in gardens and about dwellings. It has long had a popular use as a domestic remedy. Both leaves and flowering tops find some demand in the crude-drug trade.

Catnip does well on almost any good soil, but thrives best on a well-drained and moderately rich garden loam. However, a more fragrant and attractive herb can be grown in sandy situations than in heavy soils. The plant may be propagated from seeds or by root division. The seed may be sown in rows either late in the fall or in early spring and covered lightly. Fall-sown seed usually gives a more even stand and a heavier growth of herb. When the plants have reached a height of 4 to 5 inches they should be thinned to stand from 12 to 16 inches apart in the rows. In some localities the field sowing of seed does not give good results, in which case plants may be started in a cold frame and later transplanted to the field. Shallow cultivation will favor a vigorous growth of the herb.

The flowering tops are harvested when the plants are in full bloom and are dried in the shade to preserve their green color. In case the herb is grown in large quantity, it may be cut with a mowing machine, the cutter bar of which should be set high. The plants should lie in the swath until partially dry, and the curing may then be finished either in small cocks in the field or in the barn, care being taken to preserve the natural green color as far as possible.

Returns from experimental areas indicate that a yield of about 2,000 pounds of dried flowering tops per acre may be expected under good conditions. The herb must be carefully sorted and all the large or coarse stems removed, after which it may be made up for the market in bales of 100 to 300 pounds each. The prices offered by dealers usually range from 2 to 4 cents a pound.

CHAMOMILE. (See CAMOMILE.)

CONIUM.

Conium, or poison hemlock (*Conium maculatum*), is a large, poisonous European biennial plant of the parsley family, naturalized in the Northeastern States and in California. The full-grown but unripe seeds (fruits) and the leaves are used medicinally.

Conium is easily grown and has been found to thrive in both comparatively moist clay soil and in dry sandy loam. In rich, moist land it may easily become a troublesome weed. Conium grows readily from seed, which may be sown either in the fall or early in the spring in drills 2 or more feet apart. As soon as the seedlings can be distinguished in the row, cultivation similar to that given ordinary garden crops is begun. The plants usually blossom in the second year, and when the oldest seeds are full grown but still green in color the plants are harvested and the seed at once thrashed out and dried with the least possible exposure to the light. The small and undeveloped seed should be screened out and rejected and the good seed stored in containers that will exclude light and air. The leaves are collected when the plant is in flower, quickly dried in the sun, and stored in the same manner as the seed.

Estimated yields at the rate of 600 to 800 pounds of seed per acre have been obtained, but the yield is very uncertain, since the flowering plants are especially subject to the attacks of insects which destroy the crop of seed.

For several years past the range of prices as quoted in the wholesale drug markets has been from 5 to 10 cents a pound for the seed and 5 to 6 cents for the leaves.

CORIANDER.

Coriander (*Coriandrum sativum*) is an Old World annual of the parsley family. For years the plant has been cultivated in gardens in the United States, and it is now reported as growing wild in many places. The aromatic seeds and the oil distilled from them have long been used medicinally. Both the seed and the oil are also used for flavoring confectionery and cordials and as a condiment in bread and cake.

Coriander grows well on almost any good soil, but thrives best on deep and fertile garden loam. The soil should be well prepared before planting, which should be done moderately early in the spring. For field cultivation the seed is sown in rows 3 feet apart, but if the cultivation is done by hand the distance between the rows may be reduced to 18 inches. The seed should be sown thickly in order to insure a good stand. When well up, the plants are thinned

to stand 4 or 5 inches apart in the row. Cultivation should continue until the plants flower, which will be about two months from the time of planting.

When most of the seeds are ripe the plants are cut with a scythe or mower, preferably early in the morning while moist with dew, in order to avoid shattering the seed. The plants are partially cured in small cocks in the field, the drying being finished in a barn loft or under other suitable shelter, after which the seeds are thrashed out and cleaned.

The yield of seed is quite variable, but returns from experimental areas indicate that from 500 to 800 pounds per acre may be expected. Five hundred pounds of seed will usually yield from 1 to 5 pounds of oil, according to the localities where grown. The annual importation of coriander seed is about 1,300,000 pounds, valued at approximately 3 cents a pound. The wholesale price of the oil of coriander usually ranges from $5 to $7 a pound.

DANDELION.

Dandelion (*Taraxacum officinale*) is a well-known and troublesome perennial weed, occuring abundantly almost everywhere in this country except in the Southern States. It is frequently cultivated in market gardens for the leaves, which are used for greens or salads, but the root alone is used in medicine.

This plant will grow well in any good soil and has been successfully cultivated in the South, but in the colder parts of the country it may require slight mulching during the winter if the roots tend to heave out of the soil. The seeds, which are sown in the spring, are drilled in rows 18 inches apart and covered one-half inch deep. About 3 pounds of seed should sow an acre. The seedlings are thinned to stand a foot apart in the row, and the crop should be well cultivated and kept free from weeds.

The roots are dug in the fall of the second season after planting the seed. They should be washed and may be dried whole, or, to facilitate handling and drying, they may be cut into pieces 3 to 6 inches long and the larger portions sliced. Under favorable conditions, yields at the rate of 1,000 to 1,500 pounds of dry roots per acre have been obtained from second-year plants. The prices usually offered for the dry root range from 4 to 10 cents a pound. The quantity annually imported into this country varies from year to year, but averages about 40 tons.

A serious disadvantage attending the cultivation of this crop is the danger of seeding adjacent land with a very undesirable weed.

DIGITALIS.

Digitalis, or foxglove (*Digitalis purpurea*), is a fairly hardy European perennial, which has long been grown in flower gardens in this country as an ornamental plant. The leaves are used in medicine, those from plants of the second year's growth being required for the official drug.

Digitalis thrives in ordinary well-drained garden soils of open texture and reasonable fertility. Sowing the seed directly in the field occasionally gives good results, but is so often unsuccessful that it can not be recommended. The seeds are exceedingly small and do not germinate well except under the most favorable conditions. They should be mixed with sand, to insure even distribution in seeding, and sown as early as February in seed pans or flats in the greenhouse or in well-protected cold frames. When danger of frost is past the plants should be hardened off and transplanted to the field, where they may be set about a foot apart in rows spaced conveniently for cultivation.

The plants do not flower until the second year, and it is necessary to cultivate them frequently during the growing seasons of both the first and second year. In localities where the cold weather is severe it may be desirable to protect the plants during the first winter with a light mulch of straw or coarse farmyard manure.

The plants usually flower in June of the second year, and the leaves may then be collected. They are carefully dried in the shade and should be stored in such a manner that they will not be exposed to light and moisture. The results of experiments indicate that yields of 450 to 600 pounds of dry leaves per acre may be obtained under favorable conditions. During the past few years the wholesale price for the leaves has ranged from 8 to 40 cents a pound, averaging about 15 cents a pound. In considering digitalis culture it should be borne in mind that the crop occupies the soil for the greater part of two seasons and demands even closer attention than many truck or garden crops. Although it promises satisfactory profits in suitable localities, any general attempt to grow it on a commercial scale would soon result in overstocking the market.

DILL.

Dill (*Anethum graveolens*) is an Old World annual or biennial herb of the parsley family. Although it is a native of southern Europe, it is a hardy plant and may be grown in a much cooler climate if given a warm situation and a well-drained soil. The leaves are used for seasoning, and the seeds (fruits), which are greatly valued for flavoring pickles, are used as a condiment and occasionally in medicine. A volatile oil distilled from the seeds is used chiefly for perfuming soap.

Dill is preferably grown as an annual plant, in which case the seed should be sown about one-half inch deep very early in the spring in drills a foot apart. A half ounce of seed is sufficient to sow 150 feet of drill, and at this rate a pound should sow an acre. When sown in the field the rows may be 15 to 18 inches apart, and the seedlings should be thinned to stand about a foot apart in the row. The most favorable soil is a well-prepared loam, but the plants grow well in any good garden soil. Frequent cultivation and freedom from weeds are essential for good results.

Early in the fall, as soon as some of the older seeds are ripe, the plants are mowed and built up into small cocks in the field, or, if sufficiently dry, the seeds may be thrashed out at once. In very dry weather it is preferable to mow the plants early in the morning while they are moist with dew, in order to avoid shattering the seed. In case the seed is very ripe, it is well to cut the plants high and to place the tops directly on large canvas sheets, in which they may be brought from the field. After thrashing, the seeds should be spread out in a thin layer and turned frequently until thoroughly dry, since they tend to become musty if closely stored before all the moisture has been removed.

The yield of dill seed is quite variable and is much influenced by climatic conditions. From 500 to 700 pounds of seed per acre is considered a good yield. The price normally ranges from about 6 to 8 cents a pound.

ECHINACEA.

Echinacea (*Brauneria angustifolia*, fig. 6) is a native perennial plant of the aster family found on the prairies of the Middle West, occurring most abundantly in Nebraska and Kansas. The roots of the plant are used medicinally.

FIG. 6.—Echinacea (*Brauneria angustifolia*).

This plant has been found to do well under cultivation in moderately rich and well-drained loam. It grows fairly well from seeds, which may be collected when ripe and kept dry until ready for use. Plants should be started in a well-prepared seed bed by sowing the seeds thinly in drills about 8 inches apart. The plants develop slowly and may be left in the seed bed for two years and then transplanted to the field in the spring and set about 18 inches apart in rows. Thorough cultivation is essential for the best results. The roots do not reach a marketable size under three or four years from the time of sowing the seed. They are harvested in the fall, freed from any adhering soil, and dried either in the open air or by means of low artificial heat.

Echinacea has not been cultivated on a scale large enough to give satisfactory data on the probable yield. During the past few years the wholesale price for the dry root has ranged from 22 to 60 cents a pound.

ELECAMPANE.

Elecampane (*Inula helenium*) is a European perennial plant of the aster family, now growing wild along roadsides and in fields throughout the northeastern part of the United States. The root is used in medicine.

Elecampane will grow in almost any soil, but thrives best in deep clay loam well supplied with moisture. The ground on which this plant is to be grown should be deeply plowed and thoroughly prepared before planting. It is preferable to use divisions of old roots for propagation, and these should be set in the fall about 18 inches apart in rows 3 feet apart. Plants may also be grown from seeds, which may be sown in the spring in seed beds and the seedlings transplanted later to the field and set in the same manner as the root divisions. Plants grown from seed do not flower the first year. Cultivation should be sufficient to keep the soil in good condition and free from weeds.

The roots are dug in the fall of the second year, thoroughly cleaned, sliced, and dried in the shade. The available data on yield indicate that a ton or more of dry root per acre may be expected. The price to producers usually ranges from 3 to 6 cents a pound. Upward of 50,000 pounds of elecampane root were imported into this country in 1913.

FENNEL.

Fennel (*Foeniculum vulgare*) is an Old World perennial plant of the parsley family, occasionally cultivated as a garden herb in the United States. The aromatic seeds (fruits) are used in medicine and for flavoring. The oil distilled from the seeds is used in perfumery and for scenting soaps.

Fennel grows wild in mild climates in almost any good soil and thrives in rich, well-drained loams containing lime. It is propagated from seeds, which may be sown in the open as soon as the ground is ready for planting in the spring. The seed is sown thickly in drills 2 to 3 feet apart and covered lightly. From 4 to 5 pounds of seed should sow an acre. When well established the plants may be thinned to stand 12 to 15 inches apart in the row. Plants may also be started in a seed bed from seed sown either in drills 6 inches apart or broadcast. When the seedlings are 3 or 4 inches high they are transplanted to the field and set 12 to 15 inches apart in rows. The cultivation is the same as for ordinary garden crops.

Frequently, very little seed is formed the first year, but full crops may be expected for one or two succeeding years. The seed is gathered in the fall before it is fully ripe and may be harvested like anise or coriander. A yield of 600 to 800 pounds of seed per acre may be expected. During the past 10 years an average of approximately 190,000 pounds of seed and 15,000 pounds of the oil have been imported annually. The wholesale price of fennel seed usually ranges from 5 to 8 cents a pound, and that of the oil from $1.10 to $1.50 a pound.

GENTIAN.

The common or yellow gentian (*Gentiana lutea*) is the only species recognized in American medicine, although the roots of several other species are found in the drug trade. The plant grows wild in the mountains of central and southern Europe, but it has proved very poorly adapted for cultivation in situations beyond its natural range. For its best development under cultivation, partial shade, similar to that required by ginseng and goldenseal, seems necessary. The plants are said to flower when about six years old; hence, several years must elapse after sowing the seed before the roots reach a marketable size. Apparently there have been no attempts to cultivate gentian commercially in this country. During the past few years the wholesale price of imported gentian root has ranged from 4½ to 8 cents a pound.

GINSENG.

Ginseng (*Panax quinquefolium*) is a fleshy-rooted herbaceous plant native to this country and formerly of frequent occurrence in shady, well-drained situations in hardwood forests from Maine to Minnesota and southward to the mountains of Georgia and the Carolinas. It has long been valued by the Chinese for medicinal use, though rarely credited with curative properties by natives of other countries. When placed under cultural conditions, ginseng should be shielded from direct sunlight by the shade of trees or by lath sheds. The soil should be fairly light and well fertilized with woods earth, rotted leaves, or fine raw bone meal, the latter applied at the rate of 1 pound to each square yard. Seed should be planted in the spring as early as the soil can be worked to advantage, placed 6 inches apart each way in the permanent beds

or 2 by 6 inches in seed beds, and the seedlings transplanted to stand 6 to 8 inches apart when 2 years old. Only cracked or partially germinated seed should be used.

Ginseng needs little cultivation, but the beds should at all times be kept free from weeds and grass and the surface of the soil slightly stirred whenever it shows signs of caking. A winter mulch over the crowns is usually essential, but it should not be applied until freezing weather is imminent and should be removed in the spring before the first shoots come through the soil.

The roots do not reach marketable size until about the fifth or sixth year from seed. When dug they should be carefully washed or shaken free of all adhering soil, but not scraped. Curing is best effected in a well-ventilated room heated to about 80° F. Nearly a month is required to properly cure the larger roots, and great care must be taken in order to prevent molding or souring. Overheating must also be avoided. When well cured the roots should be stored in a dry, airy place until ready for sale. A market may be found with the wholesale drug dealers, some of whom make a specialty of buying ginseng root for export.

The price of cultivated ginseng root, as quoted in wholesale drug lists, has ranged during the past few years from $5 to $7.50 per pound.

A detailed account of ginseng culture is given in Farmers' Bulletin 551, entitled "The Cultivation of American Ginseng."

GOLDENSEAL.

Goldenseal (*Hydrastis canadensis*) is a native perennial, formerly quite abundant in open woodlands having ample shade, natural drainage, and an abundance of leaf mold. Its range is from southern New York and Ontario west to Minnesota and south to Georgia and Kentucky.

When grown under cultivation the soil should be well fertilized, preferably by decaying vegetable matter, such as woods soil and rotting forest leaves, which should be well worked in to a depth of 10 inches or more. Raw bone meal and cottonseed meal are also favorable in their action. Seed may be sown in October in a well-prepared seed bed. It may be scattered broadcast or dropped one-half inch apart and covered with fine leaf mold to the depth of 1 inch. During the winter the seed bed should be protected with burlap or fertilizer sacks, and should also be guarded against the encroachment of moles or mice. Plants may be set 6 to 8 inches apart each way and the rootstocks covered to a depth of about 2 inches. For satisfactory growth goldenseal requires about 75 per cent of shade during the summer, which should be provided by a lath shade or by cloth, brush, or vines. The soil should be kept free from weeds and the plants liberally watered throughout the growing season, but good drainage is necessary, since goldenseal does not thrive in boggy ground.

Under favorable conditions goldenseal reaches its best development in about five years from seed, or in a year or two less when grown from root buds or by divisions of the rootstocks. The root is dug in the autumn after the tops have withered. They are washed clean of all soil, sticks, etc., and dried on lath screens in an airy place in mild sunlight or partial shade, or indoors on a clean, dry floor. When dried in the open they should be protected from rain and dew. The cured root is kept in loose masses until marketed, since close packing may cause attacks of mold.

The market is found with crude-drug dealers and manufacturing druggists in many large cities. During the past few years market quotations have ranged from $1.80 to $5.50 per pound, but prices to producers are usually much lower than the wholesale price.

A detailed account of goldenseal culture will be found in Farmers' Bulletin 613, entitled "Goldenseal under Cultivation."

HENBANE.

Henbane (*Hyoscyamus niger*) is a poisonous annual or biennial herb of the nightshade family, introduced into this country from Europe and occasionally found as a weed in a number of the Northern States. The leaves, flowering tops, and sometimes the seeds are used medicinally.

Henbane is propagated from seeds, but when these are sown in the open field germination is uncertain, and a very poor stand or total failure is a frequent result. Germination is usually much more certain when the seeds are sown under glass, but the plants do not readily stand transplanting and often

die after they are set in the open. Very good results have been secured by sowing the seed in small pots under glass in January, transferring the seedlings to 3-inch pots in March, and transplanting in May to the field, where the plants may be set at least 15 inches apart in rows. In handling the plants care should be taken to disturb the soil about the roots as little as possible. The soil requirements and method of cultivation are practically the same as for belladonna.

The leaves of henbane usually suffer severely from attacks of the potato beetle, especially during the first year, and the crop is very likely to be destroyed if grown within the range of this insect.

Ordinarily the plants blossom about August of the second year and die after ripening their seed, but individual plants started early frequently bloom and set seed the first year. The leaves and flowering tops are collected when the plants are in full bloom and are carefully dried in the shade.

No data on probable yields in this country are available. The wholesale price for the herb during the past few years has ranged from 8 to 20 cents.

HOREHOUND.

Horehound (*Marrubium vulgare*) is a hardy perennial herb of the mint family, which occurs as a common weed in many places in the United States, especially on the Pacific coast, where it threatens to become a pest. The leaves and flowering tops find some demand as a crude drug. Their greatest use, however, is in the manufacture of candy, although they are sometimes employed for seasoning.

Horehound grows well in almost any soil and thrives in light, dry soils lacking in fertility. It grows readily from seeds, which are usually sown in drills early in the spring and covered with about an inch of soil. Plants may also be started in cold frames, either from seed or cuttings, and later transplanted to the field. Propagation may also be effected by division of old plants. Plants may stand 6, 12, or 18 inches apart in the row; those which stand close together will have small stems, and hence will yield a crop of finer quality.

The plants are harvested just before flowering, and should be cured in the shade in order to preserve the green color. If the stems are small, the plants may be cut close to the ground with a scythe, or with a mower if the area is large. In case the plants are tall and large, they must be cut some distance above the ground and all coarse stems removed to make the herb suitable for marketing.

Yields at the rate of 2,000 pounds of dry herb per acre have been obtained. The wholesale price for the herb has averaged during the past few years from 5 to 8 cents per pound. The annual importation of horehound varies from year to year, sometimes reaching 60 to 70 tons.

INSECT FLOWERS.

Insect flowers, from which pyrethrum or insect powder is prepared, are produced by several species of plants of the aster family which occur wild in the eastern Mediterranean region, where they are also cultivated.

The species here considered (*Chrysanthemum* [*Pyrethrum*] *cinerariaefolium*) has been cultivated commercially in California for the production of insect powder. This species seems to thrive best in warm situations, and should grow well in any good soil which is well drained and not too heavy. The seeds may be sown directly in the field, either early in the spring or in the fall, but it is preferable to start the plants in cold frames or well-prepared seed beds and transplant them to the field. The seed is mixed with sand and sown broadcast on the surface of the bed and lightly covered with a rake. Water should be used sparingly on the seed bed, since the young seedlings and even mature plants are easily killed by a wet soil. When the seedlings are about a month old they are transplanted, during damp weather if possible, and set 8 to 12 inches apart in rows 3 to 4 feet apart. Old plants may also be divided and used for propagation. The plants should be well cultivated during the growing season, and will yield flowers for several years if they are well cared for. The fertility of the soil is maintained by the application of fertilizers.

The time of harvesting varies from June to September, according to locality. The flower heads are gathered just as they open, and may be collected by

hand or by means of a flower picker. They are dried, preferably in the shade, on canvas sheets about 15 feet square, on which they are spread in a thin layer and turned two or three times a day until dry.

The average yield of dried flowers appears to be about 450 pounds per acre. In the trade a distinction is made between "closed" flowers and those which are "open" or full blown. The wholesale prices for the imported flowers usually range from 18 to 22 cents a pound for open flowers and 30 to 34 cents for closed flowers.

LARKSPUR.

The larkspur of the crude-drug trade is an annual plant (*Delphinium consolida*), native of southern Europe, which has long been cultivated in this country as an ornamental and is now occasionally found growing wild. Another species of larkspur (*Delphinium urceolatum*) is native to this country and is said to have properties very similar to those of the European species. Larkspur seed is now used chiefly in remedies for external parasites.

These larkspurs thrive best in a rich sandy or gravelly soil. In heavy soils they are likely to suffer from root-rot, which materially reduces the yield. A rather dry climate is suitable for plants of this character. They do not bear transplanting well and seeds should be sown in the fall or very early in the spring where the plants are to stand. The soil should be well fined and the seed thinly sown in drills spaced according to the method of cultivation to be used. When up, the plants should be thinned to stand 8 inches or more apart in the rows. The necessary cultivation consists in keeping the soil between the rows and about the plants mellow and free from weeds during the growing season.

When the seed capsules are fairly ripe, the seed is harvested by collecting the tops, which should be cut before the seed capsules have become so brittle as to risk the loss of seed by shattering and which can be handled best in the early morning while damp and pliable. They should be cured in a well-ventilated place, sheltered from rain, and when thoroughly dry may be thrashed out and cleaned.

The wholesale price quoted in 1914 for larkspur seed was between 25 and 30 cents a pound.

The seed of a European species of larkspur (*Delphinium staphisagria*), commonly called stavesacre, possesses medicinal properties and is recognized as an official drug. The wholesale price for stavesacre seed usually ranges from 10 to 15 cents a pound.

LAVENDER.

The true lavender (*Lavandula vera*) is a small shrubby plant of the mint family, native to southern Europe, and widely cultivated for its fragrant flowers and for the oil distilled from the fresh flowering tops.

Lavender thrives best in light and rather dry soils well supplied with lime, but may be grown in almost any well-drained loam. On low or wet land it is almost certain to winterkill. The plant is not easily grown from seed, but may be readily propagated from cuttings or by division. In cold climates the plants must be well protected during the winter, or they may be carried over in a greenhouse or cold frame. Early in the spring the plants or rooted cuttings are set in well-prepared soil, 12 to 15 inches apart in rows spaced to suit the cultivation intended. Frequent and thorough cultivation is desirable.

Not many blooms can be cut the first year, but full crops may be expected for each of the three following years, after which it will be best to start new plantings. The flowering tops are harvested when they are in full bloom, and if used for the production of oil are distilled at once without drying. If the dry flowers are wanted, the tops are carefully dried in the shade and the flowers later stripped from the stems by hand.

On ordinary soil yields of 600 to 1,200 pounds per acre of fresh flowering tops have been obtained. The dry weight is about four-fifths of the green weight. The yield of oil varies widely, but from 12 to 15 pounds per acre may be expected under good conditions. During the past few years the wholesale prices have averaged as follows: For "ordinary" flowers, from 5 to 12 cents a pound; for "select" flowers, from 8 to 30 cents a pound. Oil of lavender flowers has ranged in price from $1.50 to $4 a pound, the latter figure being considerably above the average.

LICORICE.

Licorice (*Glycyrrhiza glabra*) is an Old World plant, the culture of which has not succeeded commercially in this country, although the plant grows well in the arid Southwest and in California, where in some localities it threatens to become a weed. Licorice is used to some extent in medicine, and is said to be much in demand by manufacturers of tobacco.

Licorice is a fairly hardy plant, but it thrives best in warm regions, where the season is sufficiently long to promote strong growth. Plants may be grown from seed, but propagation by means of cuttings made from the younger parts of the rhizome, or so-called root, usually gives best results. The cuttings are set perpendicularly in deep, moist, sandy, or loamy soil, and should stand about 18 inches apart in rows so spaced as to allow for the cultivation necessary to keep the soil mellow and free from weeds.

The yield under good culture is said to average about 5,000 pounds of dry root per acre at the end of every third year. At present there is no market for American-grown licorice, and its cultivation, except as an experiment, seems inadvisable until a market for the crop is assured. Nearly 100,000,000 pounds of licorice root and an average of about 600,000 pounds of licorice paste are annually imported into the United States.

Wholesale prices for the imported root usually range from 4 to 5½ cents a pound in bales and from 7 to 11 cents a pound for the selected root in bundles.

LOBELIA.

Lobelia (*Lobelia inflata*) is a native poisonous annual plant, occurring generally in open woods and pastures, but is most abundant in the States east of the Mississippi River. The leaves, tops, and seeds are used medicinally.

This plant thrives under cultivation in a rather rich, moist loam, and grows well either in the open or in partial shade. It grows readily from seeds, which are very small and must be sown on soil which has been well fined and exceptionally well prepared. The seeds are sown either in the fall or spring in rows 2 feet apart. It is best not to cover the seeds but to sow them on the surface of the soil, which is then firmed with a float or by resting a board over the row and walking upon it. Fall planting usually gives a better stand and a heavier crop. Shallow cultivation should be given until the plants begin to flower.

Lobelia is harvested when in full flower or as soon as some of the older seed pods are full grown. The plants may be cut with a mower if the cutter bar is set high enough to avoid including the large stems. The herb should be dried in the shade, in order to preserve the green color.

Small areas have given yields at the rate of 1,000 pounds of dry herb per acre. The price usually paid for the dried leaves and tops is about 3 cents a pound.

LOVAGE.

Lovage (*Levisticum officinale*) is a perennial plant of the parsley family, introduced into this country from Europe as a garden plant and now grown as a crop in certain localities in New England and the West. The root has long been supposed to have medicinal properties and is in some demand in the drug trade. The flowering tops yield a volatile oil, for which, however, there is little demand. The seeds are used for flavoring confectionery and the leaf stems are sometimes blanched, like celery, and eaten as a salad.

Lovage is propagated by division or from seeds. The seeds may be planted in the fall in drills 18 inches apart or sown in early spring in a hotbed, greenhouse, or well-prepared seed bed in a sheltered portion of the garden. They should be covered very lightly with sand or fine sifted soil, and in order to prevent the soil from drying out before the seeds germinate it is advisable to spread old burlap or sacking over the bed. The sacking may be sprinkled occasionally if the weather is dry and should be removed when the first seedlings break the soil. The plants should reach a size suitable for transplanting by the end of May, when they may be set at intervals of 8 inches in rows far enough apart for convenient cultivation. Lovage grows well in almost any deep, well-drained soil, such as will produce a fair crop of corn or potatoes, and is benefited by the liberal use of fertilizer, although heavy applications of manure tend to produce excessive top growth.

The roots may be dug in October of the second or third year after setting the plants. Numerous offsets will generally be found, and if these have good roots they may be used to renew the plantation without recourse to seed. Such shoots should at once be reset at the usual distances apart. The freshly dug roots should be well washed, cut into slices about one-half inch thick, and carefully dried. If necessary, artificial heat, not to exceed 125° F., may be used to hasten drying.

Returns from experimental areas indicate that a yield of about 1,000 pounds of dried root to the acre may be expected under good conditions every third year. The prices quoted for American lovage root in the wholesale drug markets range from 45 cents to $1 a pound, according to demand and quality. Producers, however, usually receive much less than the wholesale price.

MELISSA.

Melissa, balm, or lemon balm (*Melissa officinalis*), is a perennial herb of the mint family, native to southern Europe. In this country it has long been cultivated in gardens, from which it has escaped and now grows wild in many places in the eastern United States. The leaves of balm are widely used for culinary flavoring and the leaves and flowering tops are used in medicine. The volatile oil distilled from the plant is said to be used in perfumery and also for flavoring.

Balm grows readily on any good garden soil and is easily propagated from seeds, cuttings, or by division. The seeds may be sown in the open early in the spring, but owing to their small size it is best to sow them in shallow flats in a greenhouse or in a hotbed. The soil should be well fined and the seeds sown thinly on the surface of the soil, which is then firmed with a float or a small board. When well up, the seedlings should be transferred to deeper flats, and when 4 or 5 inches high they may be transplanted to the open and set about a foot apart in rows spaced to suit the cultivation to be given. Cultivation should be frequent and sufficient to keep the soil about the plants mellow and free from weeds.

When the plants are in full flower the crop can be cut with a scythe, or with a mower if the herb is to be used for distillation. For preparing the crude drug only the flowering tops are collected, the coarse, stemmy portions of the herb being rejected. The leaves and tops are dried in the shade in order to preserve the green color.

Yields at the rate of about 1,800 pounds of dry herb per acre have been obtained, but if only the flowering tops are collected the yield will be very materially less. The price paid for the leaves and tops usually ranges from 3 to 4 cents a pound.

ORRIS.

Orris (*Iris florentina*) is a perennial, native to southern Europe, and is cultivated chiefly in Italy for its fragrant rootstocks, which yield the orris of commerce. The plant grows well in a variety of soils and flourishes in a rich, moist loam, but roots which are grown in rather dry, gravelly soil appear to be the most fragrant. Orris is readily propagated by division of the old plants, which may be set either in the spring or fall about a foot apart in rows spaced conveniently for cultivation.

Since harvesting usually takes place only once in three years, the use of the land is required for that length of time in order to obtain one crop. After the roots are dug they are peeled and dried in the open air. The desired fragrance does not develop until after the dry roots have been stored for a number of months, during which time they are especially liable to the attacks of insects.

The yield is from 5 to 6 tons of dry root per acre. The average annual importation of orris is approximately 500,000 pounds. The wholesale prices usually range from about 6 to 10 cents a pound. The outlook for a profitable orris industry in this country does not appear very promising, and it does not seem advisable for any considerable number of persons to undertake the growing of this crop.

PARSLEY.

Parsley (*Petroselinum sativum*) is a biennial herb grown everywhere in gardens for use in garnishing and seasoning. All parts of the plant contain a volatile oil, that from the seed being especially rich in a constituent known as

apiol, or "parsley camphor," which is still used to some extent in medicine. In the crude-drug trade there is a small demand for the root, leaves, and seed.

A rich and rather moist soil is desirable for the growing of parsley. The seeds germinate slowly and are frequently sown early in the spring in cold frames or seed beds, from which the young plants may be removed later and set in the open in rows 12 or more inches apart and about 6 inches apart in the row. When the leaves are fully grown they may be collected and dried in the usual manner. The plants flower in the second year, and as soon as the seed is ripe it is harvested and carefully dried. At the end of the second growing season, late in October, the root may be dug and should be well washed and carefully dried. Artificial heat may be used in drying if necessary.

On small areas yields of seed at the rate of about 185 pounds per acre have been obtained. During the past few years the wholesale price of the seed has varied from 10 to 70 cents a pound, according to demand and season.

PENNYROYAL.

Pennyroyal (*Hedeoma pulegioides*) is an annual plant, flowering from June to October, and is found in dry soil from Nova Scotia and Quebec to Dakota and southward. Both the dry herb and the oil obtained therefrom by steam distillation form marketable products.

Pennyroyal grows well on average upland soils and is frequently abundant on sandy or gravelly slopes. In field planting the seeds should be sown in rows in the fall and covered not to exceed one-quarter of an inch, since they rarely germinate if planted at a greater depth. The plants come up early in the spring, and to secure the best results clean cultivation and freedom from weeds are essential, as with all cultivated crops.

Early in the summer, when the plants are in full flower, they may be mowed. To prepare the herb for market the plants are dried, preferably in the shade, and carefully packed immediately after drying. All the large stems should be removed in order to improve the quality of the product. The herb should be marketed promptly, since it deteriorates with age. For the production of the volatile oil, the plants should be harvested when in full flower and distilled without drying.

Returns from experimental areas indicate that a yield of about 1,200 pounds of dry herb per acre may be expected. The yield of oil varies from 15 to 30 pounds per acre. The price paid for the dry herb usually ranges from 1 to 2 cents a pound. During the past few years the wholesale price of the oil has ranged from about $1 to $2 a pound.

PEPPERMINT.

Peppermint (*Mentha piperita*) is a perennial of the mint family, frequently found growing wild in moist situations throughout the eastern half of the United States. It is cultivated on a commercial scale, chiefly on the muck lands of southern Michigan and northern Indiana. The volatile oil forms the principal marketable product, but there is some demand in the crude-drug trade for the dried leaves and flowering tops.

Peppermint is propagated from "roots," or runners, which should be set in an almost continuous row in furrows about 3 feet apart and covered to a depth of about 3 inches. It can be grown on any land that will produce good crops of corn, but is most successful on the muck lands of reclaimed swamps. On uplands it soon exhausts the soil and will not do well for more than two or three seasons without the rotation of crops. On rich muck lands it will grow for a number of years, the soil being plowed after the crop is harvested and the runners turned in to form a new growth the succeeding year. It is essential that the ground be kept free from weeds, since their presence in the crop at harvest would seriously injure the quality of the oil.

When peppermint is grown on reclaimed swamps or muck lands fertilizers are rarely needed, but on uplands it is well to plow in 12 or more tons per acre of rotted stable manure before planting. Similar applications may be made between the rows in early spring and plowed in as the land shows signs of exhaustion. Commercial truck or potato fertilizers cultivated in between the rows at the rate of 600 pounds to the acre have proved useful in keeping up fertility, but manure is to be preferred, as it provides humus or vegetable matter as well as increases the fertility.

Harvesting is begun in July or August, when the plants are in full bloom. The herb is cut and cured like hay, and when fairly well dried is placed in large vats or stills having a capacity of from 1 to 3 tons of dry herb and distilled with steam to obtain the volatile oil. The yield of oil is exceedingly variable, but on lands well suited for the production of peppermint the average yield is not far from 30 pounds per acre. As shown by the last census (1910) the production of peppermint oil in the United States in 1909 was 305,781 pounds. During the past few years the wholesale price of the oil has varied from $1.40 to $3.80 a pound, averaging about $2.50 a pound. The dried leaves and tops usually bring from 3 to 5 cents a pound, but find no large demand.

PINKROOT.

Pinkroot (*Spigelia marilandica*, fig. 7) is a native perennial herb occurring in rich open woods from New Jersey to Wisconsin and south to Florida and Texas. The root is an official drug, the use of which has declined in recent years, apparently on account of the extent to which pinkroot has been adulterated with the worthless roots of another plant known as East Tennessee pinkroot. Prospective growers of pinkroot should obtain seeds or roots for planting from thoroughly reliable sources only.

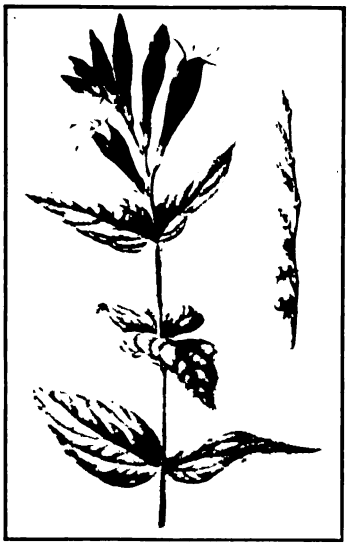

Fig. 7.—Pinkroot (*Spigelia marilandica*).

Pinkroot makes a vigorous growth under conditions suitable for growing ginseng or goldenseal, and partial shade is usually necessary, although if given a rich, moist, loamy soil it may be grown without shade in situations not too hot and dry. It is propagated either from seeds or from divisions of old roots. It is best to sow the seeds as soon as they are ripe, but if mixed with moist sand and kept in a cool place sowing may be deferred until fall or the following spring. The seeds are sown in drills 6 inches apart in well-prepared seed beds, and in the spring, when the young plants are a few inches high, they are set about a foot apart each way in the permanent beds. The old roots are divided when dormant, and each division should consist of a portion of the root with one or more buds and a number of the small rootlets. They are set in the same manner as the seedlings. Thorough cultivation and freedom from weeds are essential for good results.

The roots usually attain a marketable size in three years, but will give a heavier yield at the end of the fourth or fifth year. They are harvested in the fall, and after the tops are cut off the roots are well washed and thoroughly dried. Little can be said regarding yield, but returns from small areas indicate that a bed 4 by 30 feet will yield from 10 to 12 pounds of dry root in four years. The prices paid to collectors of pinkroot in 1914 ranged from about 15 to 30 cents a pound.

POKEWEED.

Pokeweed (*Phytolacca americana*) is a native plant of frequent occurrence in moist, rich soil along fences and in uncultivated land throughout the eastern half of the United States. The root, which is perennial, sends up large annual stems, sometimes attaining a height of 8 or 9 feet. This plant bears numerous long clusters of smooth, shining purple berries, very attractive in appearance, but the seeds are said to be poisonous. Both the root and the berries are used in medicine.

Pokeweed thrives in deep, rich soils well supplied with moisture and may be readily grown from seed sown early in the spring in rows 4 feet apart and barely covered. The seedlings may be thinned to stand about 3 feet apart in the rows. Cultivation should be shallow, though frequent. The plant develops

a long, thick, and fleshy root, which when old is not easily harvested and may have to be dug by hand. If the roots of plants grown from seed are harvested at the end of the first year, they may be turned out by means of a deep-running plow without great difficulty. As soon as they are dug the roots are cleaned by washing and are usually cut into lengthwise or transverse slices for drying. They should be thoroughly dried, and if a large quantity is to be handled the use of artificial heat will be found desirable.

A yield of about 600 pounds of dry root per acre may be expected at the end of the first year, or three or four times as much from plants of the second year's growth. In the second year several hundred pounds of berries may also be obtained from 1 acre.

Both the roots and the berries usually bring about 2 to 3 cents a pound. Apparently there is only a small demand for either of these products.

SAFFLOWER.

Safflower, American saffron, or false saffron (*Carthamus tinctorius*) is a hardy Old World annual of the aster family, cultivated in gardens in this country for its flowers, which are used in coloring or for flavoring, and sometimes as a substitute for the true saffron.

Safflower grows well on moist soils and may be readily propagated from seeds sown in the open early in the spring. The soil should be fine and mellow, and the seeds sown an inch or more apart in drills and well covered. About three weeks from the time of sowing the seed the plants will be well started, and cultivation should begin at once and be continued until the flower buds form. The plants bloom in July or August, when harvesting may begin. Only the florets are collected, and, since these must be removed by hand, harvesting is slow and expensive. The plants continue to blossom for several weeks, and the florets must be harvested almost daily. It is best to collect them early in the morning and to dry them in the shade on trays having muslin bottoms. The florets should be turned daily until thoroughly dry and then stored in tin containers.

The yield is estimated at 125 to 150 pounds of dry florets per acre. The price for safflower is variable, and during the past few years has ranged from 19 to 60 cents a pound.

SAFFRON.

The true saffron (*Crocus sativus*) is a low-growing, fall-blooming, bulbous plant of the iris family, native to southern Europe, where it is cultivated commercially. It was formerly grown as a small garden crop in some localities in this country, chiefly in Lancaster and Lebanon Counties, Pa. The stigmas of the flowers form the saffron of commerce. Saffron is used in cookery and for coloring confectionery, and was formerly widely used in medicine.

A rich, well-drained garden soil favors a vigorous growth of the plant, but a better quality of saffron is secured on land of medium fertility. It is propagated from bulbs (corms), which may be planted in August about 6 inches apart each way and 6 inches deep in well-prepared soil. When grown on a large scale the bulbs are often set late in the spring. The ground is laid off in rows about 20 inches apart, and a furrow 6 to 8 inches deep is opened for each row. In this furrow the bulbs are set in two parallel rows about 4 inches apart and about 2 inches apart in the row. The furrows are then filled and the surface of the soil brought to a uniform level. Thorough cultivation and freedom from weeds are essential for good results.

The purplish blossoms usually appear about October, but the main leaf growth of the plant is made in the following spring. The bulbs may remain undisturbed for three or four years, or they may be taken up yearly and the clusters divided. All unsound bulbs should be rejected, as they are often attacked by a fungus which readily spreads to the sound bulbs, causing them to rot. During the blossoming period, which frequently lasts from two to three weeks, the flowers are collected daily just as they open. The orange-colored stigmas are then removed from the flowers, either by pulling them out or by cutting them off with the finger nail, after which the flowers are thrown away. The stigmas are dried immediately, a common method being to spread them in a thin layer on a sieve which is suspended over a low fire. When fully dry they are placed in linen bags and stored in a dry place.

The yield of saffron is variously estimated at from 10 to 30 pounds per acre, according to the situation where it is grown. About 50,000 flowers are required to produce a pound of dry saffron; consequently, the amount of hand labor involved in removing the stigmas is quite large. The price usually received for saffron is not far from $8 a pound. The value of the annual importations of saffron into this country is about $80,000. Owing to the high cost of production, it is not thought probable that saffron culture would prove very profitable in the United States.

SAGE.

The common sage plant (*Salvia officinalis*) is a hardy perennial of the mint family, widely cultivated in gardens, and when once established it persists for several years. The leaves are used extensively for seasoning meats and soups, and a tea made from them is an old household remedy.

Sage is easily cultivated and will grow in any well-drained fertile soil, but seems to thrive best in a rich clayey loam. For cultivation on a large scale the seeds are sown in early spring in rows from 2 to 3 feet apart, and when the plants are well up they are thinned to stand about 12 inches apart in the row. Seedling plants have a tendency to produce narrow leaves; hence, the broad-leaved varieties which do not flower readily are the most desirable, since they give a larger yield of leaves. As the plants rarely set seed, they are usually grown from cuttings, which may be obtained from seed houses having their own propagating gardens. Cuttings set as early in the spring as weather conditions will permit usually give a large crop. In the North the plants should be protected in winter by a mulch of manure. Sage may also be grown as a second crop after early vegetables.

A fair crop of leaves may be harvested the first season and a much larger one for five or six years following. Only one picking should be made the first year, after which two or three pickings may be made in a season. If a product of fine quality is desired, the leaves are picked by hand and dried in the shade. Sage leaves are apt to turn black while drying unless the removal of moisture proceeds continually until they are fully dry. A cheap grade may be obtained at a smaller harvest cost by cutting the plants with a mower, the cutter bar of which is set at such a height as not to include the woody stems. The dry herb should be marketed promptly, since it loses its strength rapidly with age.

Returns from experimental areas indicate that on good soil a yield of 2,000 pounds or more of dried tops per acre may be expected. In case the leaves only are harvested, the yield will be proportionately less. During the past few years the price of imported sage has ranged from 3 to 5 cents a pound, according to quality. American leaf sage usually sells at a considerably higher price than that imported from Italy.

SENECA SNAKEROOT.

Seneca snakeroot, known also as senega or seneca root (*Polygala senega*, fig. 8), is a small native perennial, occurring in rocky woods in the eastern United States and Canada. Seneca is not yet grown on a commercial scale, although cultivated experimentally in a number of places. The root is used in medicine.

Seneca can be grown in good garden soil or in rather firm, stony soil provided it contains a fair proportion of leaf mold or very well-rotted manure. Shade is not essential, although the plant thrives in partial shade or under modified forest conditions. Roots for propagation may be obtained from dealers or may be collected from the wild in autumn or early spring. If set 15 inches apart in rows, the plants may be readily cultivated until they reach a marketable size. The seeds ripen in June and may then be planted, or they may be stratified by mixing with sand and buried in boxes or flower pots in moist soil until the following spring, when they may be sown in seed beds or shallow boxes of loam and leaf mold. The seedlings when old enough to be handled safely may be transplanted to the permanent beds and set in rows to facilitate cultivation. In cold situations they will probably need to be protected during the first winter after transplanting. A light covering of straw or pine needles will be sufficient to protect them from severe frost.

The plant is slow in growth, but experiments thus far indicate that about four years are required to obtain marketable roots. The roots should be dug

in the fall, thoroughly cleaned, and dried. There are no reliable data on the probable yield. Seneca root is in constant demand, and collectors usually receive from 35 to 50 cents a pound.

SERPENTARIA.

Serpentaria, or Virginia snakeroot (*Aristolochia serpentaria*), is a native perennial plant occurring in rich woods in the eastern part of the United States, and most abundantly along the Allegheny Mountains. The roots of this plant are used in medicine.

Like many other woodland plants, serpentaria requires a rich, moist loam and partial shade for its best development. It may be readily propagated from seeds, which, however, require several months for germination. The seeds are best sown in a well-prepared seed bed as soon as they are ripe. They may also be sown broadcast or in drills 6 inches apart and lightly covered with leaf mold. A thin mulch of straw or leaves will afford the necessary winter protection. In the spring the plants may be set 6 inches apart each way in the permanent beds. Plantings have been made in the open, in which case the plants were set 4 inches apart in rows 16 inches apart, but the results have been less satisfactory than with plantings made under shade.

FIG. 8.—Seneca snakeroot (*Polygala senega*).

The roots are collected in the fall, thoroughly cleaned, and carefully dried. Satisfactory data on probable yields under cultivation are not available. The price usually ranges from 30 to 45 cents a pound.

SPEARMINT.

Spearmint (*Mentha spicata*) is a well-known perennial of the mint family which is very frequently found growing wild in moist situations throughout the eastern half of the United States. It is widely used for seasoning meats, and the leaves and flowering tops, as well as the volatile oil distilled from the whole herb, form marketable drug products.

Spearmint is easily grown in any fertile soil which is fairly moist. Its culture and the method of distilling the volatile oil are the same as for peppermint. To prepare the dry herb for market the leaves and flowering tops are collected when the first flowers appear and before the leaves begin to fall and are carefully dried in the shade. The demand for the dry herb is small, but the annual market requirement for the oil is about 50,000 pounds.

On ordinary soils the yield of oil varies from 10 to 20 pounds per acre, according to stand and season, but on muck lands the yield is usually only a little less than that of peppermint. For several years past the wholesale prices for the oil have ranged from $1.50 to $5 a pound, averaging about $3.30 a pound. The dry herb usually brings from 3 to 4 cents a pound.

STRAMONIUM.

Stramonium, Jamestown weed, or jimson weed (*Datura stramonium*), is a poisonous annual of the nightshade family, which occurs as a common weed in almost all parts of this country except the West and North. The leaves and seeds are used medicinally.

Although stramonium grows wild on a variety of soils, it thrives best under cultivation in rich and rather heavy soils which are fairly well supplied with lime. It grows readily from seed, which may be sown in the open early in the spring in drills 3 feet apart and barely covered. When the plants are well established they are thinned to stand 12 to 15 inches apart in the row. The plants can be readily transplanted, and gaps occurring in the rows may be filled in with the plants removed in thinning. Cultivation sufficient to keep the soil free from weeds is necessary for good growth.

Cultivated plants are frequently attacked by leaf-eating insects, especially in the early stages of growth, and it is often necessary to use lime or other insect repellents to prevent the destruction of the crop.

The leaves, which are collected when the plant is in full bloom, may be picked in the field, but time will be saved if the entire plant is cut and dried in an artificially heated curing room at a temperature of 100° to 110° F. When the leaves are dry they can be readily stripped from the stems, and should be baled for shipment. Such seed as is ripe may be easily thrashed out of the capsules after the leaves have been removed from the stems.

Yields of dry leaf at the rate of 1,000 to 1,500 pounds per acre have been obtained. The yield of seed is much more variable, and is estimated to range from 500 to 2,000 pounds per acre. The price paid for the leaves varies from 2 to 10 cents a pound, while the seed usually sells at from 3 to 7 cents a pound.

TANSY.

Tansy (*Tanacetum vulgare*) is a European perennial plant, long cultivated in this country in gardens, from which it has escaped, and it now occurs as a weed along fence rows and roadsides. The leaves and flowering tops are in some demand for medicinal purposes. The herb also yields a volatile oil, for which there is a small market.

Tansy grows well on almost any good soil, but rich and rather heavy soils well supplied with moisture favor a heavy growth of herb. It may be propagated from seed, but is more readily propagated by division of the roots early in spring. The divisions are set 18 inches apart in rows 3 feet apart. Seed may be sown very early in the spring in the open or in seed beds, and the seedlings later transplanted to the field. Such cultivation as is usually given to garden crops will be sufficient.

The plants are cut late in the summer when in full flower, the leaves and tops being separated from the stems and dried without exposure to the sun, as the trade desires a bright-green color. For the volatile oil the plants are allowed to lie in the field after cutting until they have lost a considerable portion of their moisture. They are then brought to the still and the oil removed by the usual method of steam distillation.

A yield of about 2,000 pounds of dry leaves and flowering tops per acre may be obtained under good conditions. The yield of oil varies, but about 20 pounds per acre is a fair average. The price of the leaves and tops ranges from 3 to 5 cents a pound. The last census (1910) gave the production of tansy oil in 1909 as 2,598 pounds, valued at approximately $2.60 a pound. Michigan is the center of the production of tansy in the United States.

THYME.

Thyme (*Thymus vulgaris*) is a shrublike perennial plant of the mint family, native to southwestern Europe. It is a common garden plant, which lives for many years under good culture. The herb, often used for seasoning and flavoring, yields the oil of thyme, which has well-recognized medicinal properties.

Thyme grows well from seed, which may be sown early in the spring in drills 3 feet apart, or the plants may be started in a greenhouse or in seed beds outside and later set at intervals of about 18 inches in rows 2 to 3 feet apart. Thyme may also be propagated, like geraniums, from cuttings rooted in sand under glass. The plants grow well in mellow upland soil of good quality, and

should be well cultivated and kept free from weeds throughout the growing season.

For preparing the dry herb only the flowering tops are used, and these are cut when the plant is in full bloom and carefully dried in the shade in order to preserve the natural color. The volatile oil is obtained from the entire herb, which is preferably cut when in full flower and subjected to steam distillation without previous drying.

Returns from experimental areas have shown great variations in the yield, which has averaged about a ton of green herb per acre. Normally the yield from a planting increases for several years, as the plants become better established, and yields at the rate of about a ton of dry herb per acre have been reported. The price for the dry herb usually ranges from 4 to 5 cents per pound; for the imported oil, from 75 cents to $1.25 a pound, according to quality.

VALERIAN.

Valerian (*Valeriana officinalis*) is a hardy herbaceous perennial, well known under the name "garden heliotrope" and often grown as an ornamental plant. It has also been cultivated as a drug plant in New York and in parts of New England. The dried roots (rhizome and roots) form the marketable drug.

Valerian grows well in all ordinary soils, but thrives in a rich and rather heavy loam which is well supplied with moisture. It may be readily propagated by dividing the old roots, either in the fall or in the spring, and setting the divisions about a foot apart in rows 2 to 3 feet apart. If the divisions are set very early in the fall in time to become well established before frost, a good crop may usually be harvested the following autumn. Plants may also be grown from seed, which are preferably sown as soon as they are ripe in well-protected seed beds in the garden. Early in the spring the seedlings may be transplanted to the field and set at the same distances apart as the divisions of the root. Growth will be favored by a liberal application of farmyard manure, which should be well worked into the soil before the plants are set out. Thorough cultivation is essential.

The roots of the plants propagated by division may be dug in the fall of the first year's growth, although the yield will probably be small. Those of seedling plants do not usually reach a size suitable for harvesting before the end of the second growing season. After digging, the roots are washed, preferably in running water, until all adhering soil is removed. Washing and drying will be facilitated if the thick portion of the roots is sliced lengthwise. The drying should be very thorough, and the use of artificial heat will be found advisable.

Under good conditions a yield of 2,000 pounds or more of dried roots per acre may reasonably be expected. The price usually ranges from 6 to 30 cents a pound, depending upon the place where grown, that from England commanding the highest price.

VETIVER.

Vetiver, or cuscus grass (*Vetiveria zizanioides*), is a perennial of the grass family, native to southern Asia. It is occasionally cultivated in this country in the warmer portions of the Gulf Coast States as an ornamental and also for its aromatic roots, which are often used to impart a fragrance to clothing. In other countries an oil is distilled from the roots and used in the manufacture of perfumes.

Vetiver will grow in almost any soil, but light, sandy soil enriched by farmyard manure is to be preferred. Propagation is effected by dividing old clumps, which may be set in the field, either in the fall or spring, about 4 or 5 feet apart each way. During the growing season the plants are given sufficient cultivation to keep them free from weeds. Vetiver grows in close bunches from 6 to 8 feet high, the numerous roots spreading horizontally about 2 feet on all sides of the plant.

Harvesting the roots, which usually takes place in November, is a laborious operation. The soil about the plants is opened with a stout, sharp spade in a circle large enough to include most of the roots. The earth is then dug from beneath the center of the plant and the entire clump lifted. The roots are first beaten or shaken, to free them from adhering soil, then cut off close to

the root crown and thoroughly washed. They may be dried in the open air, but it is preferable to dry them in a closed room at a low temperature, since they lose in fragrance if exposed to the hot sun or to a free circulation of air.

Yields at the rate of 600 to 1,000 pounds of dry roots per acre have been obtained. The prices in the markets of New Orleans are said to range from 75 cents to $1 a pound. The oil is not produced commercially in this country. The demand for both roots and oil is quite small, and it has not yet been shown that vetiver would be a profitable crop in the United States.

WINTERGREEN.

Wintergreen (*Gaultheria procumbens*) is a low-growing, broad-leaved, evergreen plant with a creeping stem. The shoots from this stem grow to a height of 4 to 5 inches and bear solitary white flowers, which are followed by red berries. These berries are edible and are widely known as teaberries or checkerberries. Wintergreen is a common plant in woods and clearings from eastern Canada southward to the Gulf States, but its collection in quantity is somewhat difficult. Both the dry herb and the oil form marketable products.

Like other woodland plants, wintergreen thrives only in partial shade, and plantings should be made in a grove or under a specially constructed shade, such as is used for ginseng or goldenseal. A fairly good growth may be expected in soil which is thoroughly mixed with leaf mold to a depth of 4 inches or more. Wild plants may be used for propagation. Divisions of these may be set in the fall or spring, about 6 inches apart each way, in permanent beds.

Wintergreen is usually gathered in October or at the end of the growing season. The plants are carefully dried and packed in bags or boxes for marketing. For the production of the volatile oil the plants are soaked in water for about 24 hours and then distilled with steam. Over 22,000 pounds of wintergreen oil were produced in this country in 1909.

The oil distilled from wintergreen is quoted in the wholesale drug markets at prices generally ranging from $3 to $5 a pound. Collectors usually receive from 4 to 5 cents a pound for the dry herb. The results of numerous trials indicate that, on account of the small yield, wintergreen production under cultivation is not likely to be profitable at the prices quoted.

WORMSEED, AMERICAN.

American wormseed, or Jerusalem oak (*Chenopodium anthelminticum*), is a coarse weed, occurring commonly in waste places and often in cultivated ground throughout the eastern and southern parts of the United States. The seeds (fruits) and the volatile oil distilled from the tops of the plant are employed in medicine.

This plant grows well under cultivation in almost any soil, but a loamy soil is preferable, since it furnishes the conditions most favorable for the germination of the seed. Previous to planting, the ground should be deeply plowed and worked repeatedly until well pulverized. The seed is sown early in the spring with a garden drill, in rows 3 to 4 feet apart, and lightly covered. Since the seeds are very small, about a pound should sow an acre. When the plants are well up, they are thinned to stand about 18 inches apart in the row. Level cultivation will make it easier to mow the crop at harvest time. In the South a slightly different method has given good results. The ground is prepared in February and laid off in rows about 4 feet apart. A furrow is opened in each row, in which a complete fertilizer is applied at the rate of 400 to 500 pounds per acre. The soil on each side of the row is thrown in with a turnplow, forming a low ridge, which is then flattened with a light roller. The seeds are sown on this ridge with a drill. The plants are thinned to stand 18 inches apart in the row and are given frequent shallow cultivation.

The crop should be ready for harvesting late in July or early in August and should be cut before the tops begin to take on a brown color. The plants are cut either with a mower or old-style grain reaper and are left in the field until thoroughly dry. They may be housed and the seed thrashed out when convenient, but, since the seeds shatter easily, waste will be avoided if the plants are thrown upon large canvas sheets and the seed thrashed out in the field. The seed is light and not easily cleaned, but wire sieves of suitable mesh have proved very satisfactory for this purpose. When grown for the oil, the plants are cut while the tops are still green and the seed, or often the whole herb, subjected to steam distillation.

The yield of seed per acre averages about 1,000 pounds. The yield of oil varies, but about 30 pounds per acre is regarded as a fair average. The average annual production of oil is estimated at about 5,000 pounds. The price of wormseed usually ranges from 6 to 8 cents a pound. During the past few years the price of the oil of wormseed has ranged from $1.40 to $5.50 a pound.

WORMWOOD.

Wormwood (*Artemisia absinthium*) is a hardy herbaceous Old World perennial of the aster family, which has escaped from cultivation in this country and now occurs as a weed in many localities in the southern part of the United States. For many years it has been grown commercially on a small scale, chiefly in Michigan and Wisconsin. The dried leaves and tops have long been used medicinally, but the volatile oil distilled from the plant now forms the principal marketable product.

Wormwood will grow in almost any soil, but the best results are to be expected in deep, rich, moderately moist loams. The seeds are frequently sown broadcast early in the fall, following a grain crop; but if the plants are to be cultivated, it is best to start them from seeds sown in seed beds early in the spring or from cuttings of the young shoots taken in the spring and rooted in sand under glass or in the shade of a lath shed. The seeds are very small and should be sown on the surface of the soil in cold frames or seed beds and lightly covered with very fine sandy soil. The plants are easily handled and may be transplanted in moist weather with good results at almost any time during the growing season. They are set about 18 inches apart in rows 3 or 4 feet apart and are well cultivated. The soil should be kept absolutely free from weeds, since their presence in the crop at harvest time seriously damages the quality of the oil. A fair cutting of the herb may be expected the first year after planting and full crops for two or three successive seasons, after which new plantings will be found more satisfactory.

The plants are harvested when in full bloom and may be cut with a scythe, or a reaper may be used if the area is large. While still fresh, the plants are distilled with steam to obtain the volatile oil. To prepare the leaves and flowering tops for market they are stripped from the stems by hand after the plants are cut and carefully dried in the shade without the use of artificial heat.

Experimental plantings have given yields at the rate of 2,000 pounds of dry tops or 40 pounds of oil per acre. When grown on a commercial scale the yield of oil appears to average about 20 pounds per acre. The dry tops usually sell for about 6 or 7 cents a pound. The demand for the oil has fallen off in recent years, and as a result the price has declined, until in the latter part of 1914 it reached the low level of about $2.40 a pound. The annual production of oil of wormwood is about 2,000 pounds, but apparently there is little possibility at present for the profitable expansion of this industry.

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE ON DRUG PLANTS, ETC.

PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION.

Weeds Used in Medicine. By Alice Henkel. Pp. 45, figs. 31. 1904. (Farmers' Bulletin 188.)

Growing and Curing Hops. By W. W. Stockberger. Pp. 39, figs. 20. 1907. (Farmers' Bulletin 304.)

Harmfulness of Headache Mixtures. By L. F. Kebler, F. P. Morgan, and Philip Rupp. Pp. 16, 1909. (Farmers' Bulletin 377.)

Habit-Forming Agents: Their Indiscriminate Sale and Use a Menace to the Public Welfare. By L. F. Kebler. Pp. 19, figs. 5. 1910. (Farmers' Bulletin 393.)

The Cultivation of American Ginseng. By Walter Van Fleet. Pp. 14, figs. 3. 1913. (Farmers' Bulletin 551.)

Goldenseal Under Cultivation. By Walter Van Fleet. Pp. 15, figs. 5. 1914. (Farmers' Bulletin 613.)

The Source of the Drug Dioscorea, with a Consideration of the Dioscoreæ Found in the United States. By Harley Harris Bartlett. Pp. 29, figs. 8. 1910. (Bulletin 189, Bureau of Plant Industry.)

Some Effects of Refrigeration on Sulphured and Unsulphured Hops. By W. W. Stockberger and Frank Rabak. Pp. 21. 1912. (Bulletin 271, Bureau of Plant Industry.)

PUBLICATIONS FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS.

The Adulteration of Drugs. By Lyman F. Kebler. Pp. 251–258. 1904. (Separate 331, from Year book of the Department of Agriculture, 1903.) Price, 5 cents.

Peppermint. By Alice Henkel. Part 3, pp. 19–29, figs. 3. 1905. (From Bulletin 90, Bureau of Plant Industry.) Price, 5 cents.

Wild Medicinal Plants of the United States. By Alice Henkel. Pp. 76. 1906. (Bulletin 89, Bureau of Plant Industry.) Price, 5 cents.

American Root Drugs. By Alice Henkel. Pp. 80, figs. 25, pls. 7. 1907. (Bulletin 107, Bureau of Plant Industry.) Price, 15 cents.

The Sources of Arsenic in Certain Samples of Dried Hops. By W. W. Stockberger. Part 4, pp. 41–46. 1908. (From Bulletin 121, Bureau of Plant Industry.) Price, 5 cents.

American Medicinal Barks. By Alice Henkel. Pp. 59, figs. 45. 1909. (Bulletin 139, Bureau of Plant Industry.) Price, 15 cents.

American Medicinal Leaves and Herbs. By Alice Henkel. Pp. 56, figs. 36. 1911. (Bulletin 219, Bureau of Plant Industry.) Price, 15 cents.

The Diseases of Ginseng and Their Control. By H. H. Whetzel and J. Rosenbaum. Pp. 44, figs. 5, pls. 12. 1912. (Bulletin 250, Bureau of Plant Industry.) Price, 15 cents.

American Medicinal Flowers, Fruits, and Seeds. By Alice Henkel. Pp. 16, figs. 12, 1913. (Bulletin 26, U. S. Department of Agriculture.) Price, 5 cents.

Wild Volatile-Oil Plants and Their Economic Importance. I.—Black Sage; II.—Wild Sage; III.—Swamp Bay. By Frank Rabak. Pp. 37, figs. 6. 1912. (Bulletin 235, Bureau of Plant Industry.) Price, 5 cents.

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Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.

STRAWBERRY GROWING IN THE SOUTH.

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INTRODUCTION.

The strawberry is the most valuable of the small-fruit crops grown in the United States. In 1909 the acreage was one-half and the value—nearly 18 million dollars—was three-fourths of the total for all small fruits. This valuation is based on commercial areas and does not include the small home-garden patches, which would probably nearly double the value. The South, including the States south of the Potomac and Ohio Rivers and east of the Mississippi, together with Arkansas, Louisiana, and Texas, produced about one-fourth of the total for the United States. The average yield of strawberries per acre for the whole country was a little less than 1,800 quarts and the farm value $125 per acre.

CHOICE OF LOCATION.

An important consideration in growing strawberries for the northern markets is to select a location where the climatic and soil conditions are conducive to the early ripening of the fruit, so there will be little competition from regions farther north. In many southern sections where strawberries are produced on a commercial scale, shipments practically cease as soon as berries from a more northern region begin to move in car lots. This is due to the fact that toward the end of the picking season the berries are small and can not compete successfully with the larger fruit from a region nearer the market that is just beginning to harvest its crop.

NOTE.—This bulletin is intended to meet the needs of all growers of strawberries in the South, more especially those who are producing on a commercial scale.

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PROPAGATION.

The strawberry is propagated commercially by runners from old plants. The runner first forms leaves; then takes root. This young plant receives nourishment from the mother plant until it is capable of self-support, when the runner dies. The new plant, as soon as it is well established, often sends out runners and forms other plants. These young plants that have not produced fruit are the ones used for setting new plantations.

Propagation by seed is never resorted to except for the production of new varieties, since no one can foretell what kind of fruit will be produced by a seedling plant. All new varieties, however, come from seed, either through normal variation in the seedlings or through variation induced by crossing two distinct varieties. When two varieties are crossed for the purpose of combining their desirable qualities, the resulting seedlings will show every combination of characters, with perhaps a few possessing the desired characters of both parents. In practice, however, most new varieties come from seeds the parentage of which is not known.

SOILS FOR STRAWBERRIES.

SELECTION OF THE SOIL.

While strawberries will grow on nearly all types of soil, a sandy or gravelly loam gives the best results. In the South a warm, quick soil, although poor, is preferable to a heavy retentive soil well supplied with plant food. Plant food can be supplied by the addition of fertilizers, but the physical condition of the soil can only be modified with difficulty by cultivation, drainage, and the addition of humus. The time of ripening can be influenced to some extent by selecting soils and exposures which force or retard maturity. A light, well-drained soil with a southern or eastern exposure will hasten the maturity of the berries, while heavy moist soils with a northern exposure will tend to make the crop late. Heavy mulching will also delay ripening.

The soil for strawberries should be well supplied with organic matter (humus) in a well-decomposed state. Many growers believe that new land is essential for good results, but if old soils are well supplied with organic matter they will yield as large crops as the new soils. The main difference between old and new soils is in the supply of humus and the mechanical condition due to the presence or absence of humus. The soil should be well drained, but should hold moisture during dry weather. Organic matter in a well-decomposed state in the soil makes it retentive of moisture. In sandy soils the organic matter fills up the spaces between the soil particles and checks evaporation, while in clay soils it prevents the

soil from running together and baking and thereby prevents excessive loss of moisture by capillarity and evaporation.

A soil containing large quantities of nitrogen should be avoided, as such a soil will produce a heavy, dense growth of foliage at the expense of fruit. Weeds will be more troublesome and the fruit will not ripen as evenly on soil of this type.

PREPARATION OF THE SOIL.

The soil on which strawberries are to be grown should be thoroughly prepared, and to secure best results this preparation should begin at least a year before the plants are to be set. On weedy land a cultivated crop or one that will smother out the weeds should be grown the year preceding the planting of the strawberries. A good practice, followed by some growers, is to plant corn with cowpeas between the rows the year before the strawberry plants are set. The cultivation of the corn keeps down the weeds during the early part of the season, and the cowpeas choke them out during late summer. The cowpeas also add nitrogen and humus, both of which are important, but usually deficient in the soil. The cowpeas and corn stubble should be turned under during the fall or winter, to insure their decay before dry weather begins. In the spring the land should be replowed and then harrowed every 10 days or two weeks up to planting time, in order to kill the weeds and pulverize the soil. The plowing should be deep, so as to increase the water-holding capacity of the soil.

On level, poorly drained soils it is necessary to set the plants on raised beds or ridges. The beds should be as flat and wide as conditions will allow, for high, narrow beds dry out more quickly. The ridges or beds are commonly made by throwing together two or four furrows with a 1-horse turnplow and leveling the top with a light drag. It is much better to make the beds wide enough for two or more rows than to make one bed for each row. This practice is followed with good results in some sections of the South.

Where there is no danger in an average season that the plants will be injured by excessive moisture, flat culture gives the best results.

FERTILIZERS.

Few soils that are adapted to strawberry growing are rich enough to produce large crops of fruit without the addition of manures or fertilizers of some kind.

Stable or barnyard manure is the best fertilizer for strawberries, because it furnishes both plant food and humus; but manure containing weed seed should be avoided. The best way to enrich strawberry land is to apply manure to the crop preceding the strawberries, in order that it may decompose and become well incorporated with

the soil and so that most of the weed seeds will have germinated by the time the plants are set. If manure is to be applied the season the plants are set, only well-rotted manure should be used. After the land has been plowed the manure should be spread broadcast at the rate of 10 to 20 tons per acre, depending upon the fertility of the soil, and harrowed in.

Manure does not contain sufficient phosphoric acid and potash, and for that reason it should be supplemented by the use of commercial fertilizers rich in these elements.

When manure is not available, the plant food should be supplied by means of commercial fertilizers and green-manure crops. The commercial fertilizers will supply the plant food, but since they do

FIG. 1.—Field of strawberries planted in accordance with the hill system as practiced in Florida.

not add humus it is necessary to turn under green crops to keep the soil in good mechanical condition. Some of the best crops for this purpose are cowpeas, soy beans, velvet beans, vetch, and the clovers, as these crops will add nitrogen in addition to the humus. When phosphorus and potash are necessary, they can usually be supplied most economically in acid phosphate and muriate or sulphate of potash. Many growers use a high-grade complete fertilizer, but as a rule better results can be secured if a part of the nitrogen is supplied by means of leguminous crops or manure.

If neither manure nor legumes are available, a complete fertilizer should be used, but a maximum crop can not be secured in this way unless the soil is in perfect mechanical condition. In some sections of the South a ton or a ton and a half of high-grade fertilizer per acre is used, but this quantity is not economical. If 1,000 or 1,500

pounds of fertilizer will not produce large crops, the soil is either not suited to strawberries or is deficient in humus. Large applications of fertilizer will not make up for the lack of vegetable matter or humus in the soil. Heavy applications of fertilizers are profitable only when used on soils in a good physical condition and well supplied with humus.

When a commercial fertilizer is used in large quantities, two or more applications should be made. The first application should be made before the plants are set, and it may be scattered broadcast or under the rows; later applications may be made during the growing season as side dressings. When as much as 1,000 pounds is used at the first application it is advisable to scatter it broadcast; smaller quantities should be applied in the furrow and thoroughly mixed with the soil. If all the elements are to be supplied by means of commercial fertilizers, a mixture containing 3 to 4 per cent of nitrogen, 6 to 8 per cent of phosphoric acid, and 6 to 8 per cent of potash will be satisfactory. In the South cottonseed meal, acid phosphate, and muriate of potash are the fertilizers most often employed. A mixture containing 800 pounds of cottonseed meal, 800 pounds of acid phosphate, and 250 pounds of muriate of potash gives the elements in about the right proportion for the lighter soils. Apply this at the rate of 800 to 1,500 pounds per acre, depending upon the fertility of the soil. If the soil contains a great deal of potash, part of the muriate of potash may be left out; on soils that make a good growth of foliage it will not be necessary to use as large a quantity of cottonseed meal. Where fish scrap or tankage can be secured to better advantage, 600 pounds of the former or 500 pounds of the latter can be substituted for the cottonseed meal.

SYSTEMS OF GROWING.

There are three systems of growing strawberries: The hill system, the matted-row system, and an intermediate between the two, sometimes known as the hedgerow system.

THE HILL SYSTEM.

In the hill system the plants are set in hills (fig. 1), one plant in a place, and no new plants are allowed to form. This makes a large, vigorous plant, producing large, uniform berries which ripen evenly. This is the system that is followed in Florida. One reason why the hill system is used in that State is undoubtedly because it is necessary to take advantage of as much sunlight as possible in order to properly color and mature the berries during the short days of the ripening season. The berries would be more shaded if other systems were used, and with the short days and the large amount of humidity in the air they would not color well and many would rot on the vines.

The high cost of growing the fruit in Florida and the heavy transportation charges to the northern markets make it important to secure the greatest possible percentage of large, well-ripened berries, and this can be done under the hill system. The quantity of berries that can be produced by following this system is not always so large as under the other systems, but the quality is much better, and the percentage of first-class berries and the prices received are higher than under the other systems.

THE MATTED-ROW SYSTEM.

In the matted-row system (figs. 2 and 3) the runners are allowed to set plants 6 to 9 inches on either side of the row. If the belt of plants

FIG. 2.—Field of strawberries, showing the system of very wide matted rows used in some sections of the upper South.

is to be as wide as 18 inches, the rows should be at least 3½ feet apart, in order to allow room for cultivation. A larger quantity of berries is grown under this system than under any other, but the fruit is usually smaller and does not ripen as well. The percentage of high-class fruit is lower in the matted rows than when the hill system is followed, but the work of cultivation and thinning is less than under any of the other systems, and for that reason it is used by most growers. Most of the growers who use this system allow their fields to bear for two or more years, and in order to renew the patch they often cultivate the middles and induce new runner plants to take possession of them. After the middles are well stocked with plants, the old rows are turned under and form the alleys between the new rows.

THE HEDGEROW SYSTEM.

The hedgerow system is intermediate between the hill and the matted-row systems, and has some of the advantages of both. In the hedge-row system (figs. 4 and 5) the runners are allowed to form plants along the row in a strip a few inches wide. After this strip is well stocked with plants the runners are cut off. The advantage of this over the matted-row system is that more air and sunlight reach the fruit, resulting in larger and more uniform berries. More berries are produced by using the hedgerow than by the hill system. This is the system most commonly practiced in the southern part of the lower tier of Southern States with the exception of Florida.

FIG. 3.—Field of strawberries set in narrow matted rows with a mulch between.

In some cases the field is plowed after one crop has been produced, and in others it is allowed to bear for two or more years.

In Florida the hill system gives the best results, while in most other sections either the hedgerow or matted-row system is preferred. Where large berries with the best table qualities are more important than heavy yields, the hill system should be used. In most commercial plantings a heavy yield is of prime importance, and the hedgerow or matted-row system should then be employed, except where climatic and other conditions do not favor these methods, as in Florida.

PLANTING STRAWBERRIES.

TIME OF PLANTING.

The time to plant strawberries varies in different sections of the South. In Florida they may be set at any time from June to November whenever the soil and weather conditions are favorable. In the

southern sections of the South Atlantic and Gulf Coast States the plants are set out in late summer or autumn. In both cases the crop is harvested the following spring. In other sections of the South the plants are set in late winter or early spring and the crop is not harvested until the following year. Plants set out in the spring and not expected to carry a crop until the following spring should have the blossoms kept off during the summer, so that the vigor of the plants will not be impaired.

SOURCE OF PLANTS.

Many growers use young plants from the old beds for setting new plantations, while others buy from plant dealers. The first method is

FIG. 4.—Field of strawberries planted according to the wide hedgerow system.

satisfactory if only strong and healthy young plants are selected; old plants that have produced fruit do not give good results and should never be used. A practice followed in many sections is to cultivate and fertilize the fields after the berries are harvested, in order to get a good growth of runners. When the young plants reach the proper size for planting they are taken up and set out in the new fields. This is a good practice and should be generally followed where plants from the old patch are used. Plantations that do not produce fruit make stronger plants for setting than those that produce both fruit and plants.

PERFECT AND IMPERFECT FLOWERS.

Some varieties of strawberries have both stamens and pistils (male and female organs) and are called "perfect flowered," while others have only pistillate (female) flowers. When planting strawberries

the grower should give careful attention to this point, for pistillate plants will be unproductive when planted alone. When varieties with only pistillate flowers are selected they should be planted with perfect-flowered varieties. A common practice where imperfect varieties are used is to plant one row of perfect-flowered varieties to three or four rows of imperfect, or pistillate, plants. In such a planting system the pollen from the perfect flowers fertilizes the imperfect blossoms. Figure 6 shows perfect and imperfect flowers. When the flowers are not properly pollinated, the result is a large number of nubbins or deformed berries. Sometimes during the blossoming

FIG. 5.—Field of strawberries planted in accordance with the hedgerow system, at the beginning of the blossoming period in Louisiana.

period conditions, such as frost or heavy rains, prevent perfect pollination even when the varieties are perfect flowered.

METHODS AND DISTANCE OF PLANTING.

The distance to set the plants depends upon the methods of culture to be followed. In sections of Florida where the plants are grown in hills they are set 12 to 14 inches apart in rows 3 to 3½ feet apart. In southern Louisiana they are set about 10 inches apart in rows 3 to 3½ feet apart. In most other sections of the South the plants are set 15 to 18 inches apart in rows 3½ to 4 feet apart. Some growers set the plants in checks 3 by 3½ feet and cultivate both ways until runners begin to form. This is satisfactory if the plants have a full year in which to grow new plants for bearing fruit and is the best method for those varieties which are prolific plant makers.

Several methods are followed in setting plants in the field. A good method is to use a spade to open the hole. One man thrusts the spade into the soil and moves the handle forward, thus opening a broad hole. A second man spreads the roots of the plant in fan shape, places them in the hole, and packs the soil with his foot after the spade is withdrawn; or the spade may be inserted about 6 inches in front of the plant and the soil pressed against the plant by a backward movement of the handle. Another method sometimes followed is to open a furrow with a 1-horse turnplow, set the plants against the land side, and pull the loose dirt up to them. In a third method the hole is made with a dibble. This is not very satisfactory, because the plant can not be placed in a small round hole without matting and cramping the roots. Some growers have secured very good results with a plant-setting machine which waters the plants as they are set. If the soil is dry, a small quantity of water should be poured around each plant at the time of setting, no matter which method is used. After the water sinks into the ground a little dry soil should be pulled up around the plant to prevent the baking of the soil.

FIG. 6.—Perfect strawberry flowers (1 and 2) and an imperfect flower (3).

The greatest care should be exercised to set the plants so that the crown is just above the surface of the soil. If set too shallow the roots will dry out by being exposed, and if too deep the crown or terminal bud will be covered with soil and will not grow. Before setting the plants the roots should be pruned back one-third or one-half their length, so they will not be cramped. Most of the top should also be removed, to prevent excessive loss of moisture through the leaves. Not more than two or three of the youngest leaves should be left.

CULTIVATION.

Clean, shallow cultivation should be followed throughout the season. Good cultivation keeps down the weeds, allows the rains to penetrate the soil, and prevents the excessive evaporation of moisture. Cultivation should begin soon after the plants are set and should be continued whenever weeds start or a crust forms. The main objects of cultivation are to break up the crust and to prevent the loss of moisture from the soil below the surface, which is accomplished by forming and maintaining a blanket of loose soil on the surface. Frequent shallow cultivation will make it unnecessary to use a sweep to kill weeds and grass, which is often necessary under the methods of culture now in common use in the South. A culti-

vator which merely breaks up the surface of the ground without disturbing the roots is to be preferred. In addition to using the horse cultivator it will be necessary to do some hand hoeing, to keep down the weeds and to keep the soil loose between the plants in the row. Weeds will sometimes have to be pulled by hand, and they should never be allowed to become large, because when large weeds are removed the strawberry plants will be disturbed.

MULCHING.

Mulching is a very important operation in connection with strawberry growing, as it prevents the excessive loss of moisture, prevents "heaving out" in regions where freezes occur, keeps the berries clean, keeps down weeds, retards growth in cold regions (thus preventing frost injury), and adds humus to the soil. The important objects of mulching in the South are conserving moisture, protecting the berries from dirt, and keeping down weeds. Mulched plants are said to suffer less from spring frosts than those in the same area not mulched. Strawberries are not usually cultivated during the picking season, because stirring the soil tends to make the fruit dirty and gritty; but unless the plants are mulched they are apt to suffer from drought, which often occurs at this season, causing a serious reduction in yield. There would not be as much loss due to drought if the plants could be kept cultivated during the picking season, but as cultivation is objectionable, mulching is a very effective substitute.

MULCH MATERIAL.

There are many materials that can be used for mulching, but their value depends largely upon their freedom from weed seeds. Wheat, rye, and oat straw, strawy manure from the horse stable, pine straw, and marsh hay are the materials most commonly used. All of these are satisfactory when they can be secured in sufficient quantity and are free from weed seeds or grain. Pine straw is the best material to use so far as ease of application and keeping the berries clean are concerned, but it is not as valuable a source of humus as the other materials and can not be secured in all regions.

TIME OF APPLYING MULCH.

The mulch should be applied during the late fall or winter whenever the soil will not be injured by driving on it. A sufficient quantity should be used to conserve the moisture and to protect the berries from dirt by keeping them off the ground. A mulch 2 or 3 inches thick is adequate for this purpose. If there is no mulch between the rows the soil should be cultivated before picking begins. Even when there is a mulch it is a good plan to remove this material and cultivate; it can then be replaced.

DURATION OF PLANTATION.

The length of time that a field should be allowed to produce fruit depends upon many conditions and varies in different sections of the South. In sections where weeds and grass grow very rapidly, where the picking season is long, and where the fields become foul during the harvesting season, one crop is all that should be grown. Under these conditions it costs quite as much to clean out the old plantation as it does to make a new one, and a new planting nearly always yields a larger and better crop.

In most sections, with the exception of the extreme South, where strawberries are grown under the hill system and a new planting is made each year, the plants are allowed to bear for two years or more. Two crops under most conditions should be the maximum. In some regions the fields bear as many as six crops before being renewed, but in nearly every instance where this practice is followed the crops are not satisfactory after the second year. It is possible to clean up the patch each year in such a way that large crops can be secured for a period of five or six years, but very few growers give the field the attention necessary to produce large crops of first-class fruit. In most cases the berries are small and of inferior quality after the second year, because of the crowding of the plants and the poor physical condition of the soil.

Where the fields bear more than one crop, they should be thoroughly cleaned out, thinned, cultivated, and fertilized after the fruit has been harvested. Most growers do not give the fields the needed attention. It is just as necessary to give good cultivation and to add fertilizer during the second season as it is during the first. When this is properly done a good crop will be produced the second year. The best quality of fruit is nearly always produced on the new planting, however, and for this reason frequent renewal is recommended. One argument against planting every year is that the land is used two years and only one crop is produced. This is usually the case where the plants are set out in the spring, but a crop of late Irish potatoes or some other vegetable can be grown after the strawberries have been harvested and two crops secured in this way. In some sections where strawberries are planted in the spring, they are interplanted with crops like potatoes, peas, or beans. If the plants are set in the late summer or autumn a crop of early vegetables can be grown before the strawberry plants are set. Better results can be secured, however, where cowpeas, soy beans, or some other leguminous crop is grown and turned under.

RENEWING OLD BEDS.

When strawberries are grown under the hill system, the usual practice is to make a new planting each year, but under the other systems the old beds are often renewed. When old plantations are

to be kept over, the fields should be mowed soon after the berries are harvested and the tops and weeds burned. This burning will destroy many insects and diseases and will not injure the plants if done on a windy day when the field will burn over quickly. After the tops and weeds have been burned, thorough cultivation should be given between the rows and the plants thinned by removing the old plants, in order to allow the new ones to form runners. A good practice followed by some growers is to plow out part of the row and allow the runners from the remainder of the row to cover the cultivated section. When the new portion is well stocked with plants the old portion should be turned under. Whenever the plantation is kept for more than one year the soil should be fertilized and cultivated as for a new planting.

ROTATION.

A systematic rotation of crops is just as important in growing strawberries as it is in growing other crops, but very few growers practice it to any great extent. Soil on which strawberries are raised year after year does not produce as large crops of fruit as it would were a good system of rotation followed. In any system of rotation some leguminous crops should be grown and turned under one year in every three or four years, and a cultivated crop grown on the soil the season before the strawberry plants are set.

For the South the following system can be employed to good advantage: Strawberries for one or two years, followed by cowpeas after the strawberries are harvested. Turn under the cowpeas in the fall or winter or harvest them for hay. The next spring plant the land to some vegetable crop, such as early cabbage, and follow with a fall crop of vegetables or cowpeas for turning under. Plant the land to corn the following spring and plant cowpeas between the rows. After the corn is harvested, turn under the stalks and the pea vines. When strawberries are planted in the fall, they can be set out after the cowpeas and cornstalks are turned under. A second system that can be followed is strawberries one or two years, followed by a fall crop of vegetables after the berries are harvested. The next spring plant to vegetables, and follow with cowpeas, and then either plant strawberries again or grow corn and cowpeas followed with strawberries. In sections where vegetables are not grown commercially, oats can follow the cowpeas that are turned under the season the strawberry field is plowed, and either cowpeas or peanuts can follow the oats. The following year plant the land to corn, with cowpeas between the rows; then return to strawberries. By following a good rotation system, such as has been suggested, the yield of strawberries will be greatly increased and the cost of cultivation lowered.

HARVESTING STRAWBERRIES.

PICKING THE FRUIT.

The stage of maturity at which berries should be picked depends upon the distance they are to be shipped. When grown for a local market they should be picked when thoroughly ripe but not soft. If grown for a distant market the berries must be picked before they are thoroughly ripe, but they should be fully grown and about three-fourths ripe. If picked before they are colored the berries will shrink and wither, making them unfit for sale. Strawberries should be picked with a short piece of stem attached (about one-fourth to one-half inch). They should never be slipped from the

FIG. 7.—American quart boxes of well-graded strawberries: "Fancy" on the right, "No. 1" on the left.

stem, as that spoils their appearance and injures their shipping and keeping qualities.

PACKING THE FRUIT.

Uniformity in the pack is essential in order to obtain high prices for strawberries, and this can be secured only when the berries have been carefully graded and sorted. Some growers have the berries graded in the field. The pickers carry several boxes in the picking tray and as the berries are picked they are graded according to size, the different grades being put in separate boxes. This method is satisfactory when experienced pickers are employed, but with the average help that can be secured it is best to have the grading done in a packing shed by a few expert graders and packers. This work is generally done by women.

A common practice in some sections is to pick the ripe berries of all grades into the same box and when the tray is full to take it to the packing shed, where the berries are sorted and packed. The graders dump the berries on a table and pick out all green, overripe,

or small berries. The others are placed in the boxes, one of the graders arranging the top layers in such a way that the berries show to best advantage. When berries are packed in this manner, care should be taken not to put the small, inferior berries in the center of the box and the large fine berries on top. The fruit should be uniform throughout the box, with the top layer merely placed to add to the attractiveness of the pack and to hold the fruit in place. Where a fancy pack is put up, the berries should be divided into two grades, as shown in figure 7.

After the berries are picked they should be placed in the shade as soon as possible, for heat injures the fruit in a short time. The pickers should not be allowed to leave the filled boxes along the

FIG. 8.—Crate of Aroma strawberries in octagon quart boxes, 24 quarts to the crate.

rows, where the berries will be exposed to the sun. The shorter the time that elapses after the fruit is picked before it is put into refrigerator cars or refrigerator boxes the better it is for the berries, which will continue to ripen rapidly until they are chilled.

PACKAGES.

Many different types of boxes and crates are used for strawberries, but the tendency is toward a standard full-size quart box. In fact, in several States it is illegal to offer for sale a short box; shipments to these markets must be handled to conform with the laws. The boxes now in use are the American or standard quart berry box, which holds a full quart; the octagon box, shown in figure 8; and the square scale-board type of quart and pint boxes, shown in figure 9. The American type, shown in figure 7, is the one that is most generally used; it is full size, strongly made, and packs well in the

crate. The octagon box, shown in figure 8, is objectionable on account of its shape and the raised bottom. A long, narrow box is not satisfactory, because it is inconvenient to pick up without grasping the sides between the thumb and fingers, and when handled in this way the berries are likely to be mashed. Moreover, the sides of boxes with raised bottoms often split off below the bottom, causing the boxes to tip over. The scale-board boxes are cheaper than splint boxes, but as the latter are more substantial they are preferred in nearly all markets. The type of crate depends on the boxes that are used. Any crate that is substantially built and well ventilated is satisfactory, but cost is an important consideration, as

FIG. 9.—Crate of well-graded Klondike strawberries packed in square pint boxes with raised bottoms, 24 pints to the crate.

they are not returned to the shipper. The largest crate that can be handled conveniently is the one to use, as the large ones are cheaper in proportion to the quantity of berries they carry. The 24 or 32 quart crates are generally used, though in some sections the 60-quart crate is employed. Crates with hinged lids have an advantage over others in that they provide for the inspection of the fruit to better advantage. The hinged-lid crate invites inspection and this is a point in its favor.

A large part of the strawberry crop grown in Florida is shipped to northern markets in refrigerator boxes similar to the one shown in figure 10. These boxes, or pony refrigerators, hold 64 or 80 quarts of berries. After the boxes of berries are placed in the refrigerator a metal tray (fig. 10) is put in place above the berries and filled with ice. The main advantage in using these refrigerator

boxes is in long-distance express shipments where refrigeration is necessary.

In order to bring the highest market price berries must be well graded and sorted, carefully packed, and put up in clean, neat, attractive packages of standard size. Figure 11 shows a good type of crate holding 32 full quarts of well-graded fruit. The grower should see that the berries are honestly and conscientiously graded and put up uniformly throughout the package.

VARIETIES OF STRAWBERRIES.

The varieties of strawberries that are grown in any given region change so rapidly that a list suitable for this year would need to be

FIG. 10.—Pony refrigerator used in Florida for express shipments of strawberries to northern markets. The ice tray is on the floor to the right of the refrigerator.

revised in a few years. While some of the best varieties grow well in many localities, others are of local adaptation. The question of the variety or varieties to grow depends upon many factors. What would be considered a good variety for a home garden might not be at all suited for distant markets. A good market variety should be a heavy bearer, of good size and attractive appearance, and, above all, one that stands shipment well. Such a variety may not be of first-class quality. For the home garden, quality is the first consideration, while the carrying quality need not be considered. In the home garden there should be a succession of crops from early to late, while in a commercial plantation the season of the variety or varieties grown is determined by the markets. As a rule, the com-

mercial grower plants only one variety, or a few varieties at most, and these are usually selected with the purpose of reaching the market at a time when there is the least competition from other sections. For this reason many of the regions of the South grow the same varieties and depend upon the difference in the season of maturity to prevent competition with each other. If early, medium, and late varieties were grown, the late variety in the southern regions would compete with the early variety in the sections a little farther north.

In the South at the present time the varieties considered the best for commercial purposes are the Klondike, Lady Thompson, Mission-

FIG. 11.—Crate of well-graded Missionary strawberries in American quart boxes, packed in a ventilated crate holding 32 quarts.

ary, Excelsior, and Aroma, the first-named being grown more than any other variety. Where a succession of crops is desired, the Excelsior is grown for an early variety; the Klondike, Missionary, or Lady Thompson for medium, and the Aroma for later ripening. In Florida at the present time the Missionary is the most popular variety, but the Excelsior and Klondike are also grown. In Georgia, North Carolina, and South Carolina the Lady Thompson, Klondike, and Excelsior are the most popular varieties. In Louisiana, Arkansas, and Mississippi the Klondike is grown more than all other varieties, though in Arkansas some commercial growers use the Lady Thompson, Excelsior, and Aroma. In the Ozark section of Arkansas and Missouri the Aroma is the most popular variety, although the Klon-

dike is also grown to some extent. In the commercial strawberry-growing region of western Tennessee, the Klondike, Excelsior, and Gandy varieties are grown. The strawberry section of eastern Virginia uses the Klondike, Excelsior, Missionary, and Early Ozark, the first named being the leading variety.

COST OF GROWING STRAWBERRIES.

The cost of growing strawberries varies between wide limits, depending upon the locality and the methods of culture. In most sections of the South the average cost of production is $75 to $90 per acre, but in some places the cost is very much higher, especially in Florida.

Below is an estimate of the cost per acre of growing strawberries in the South:

Interest on investment in land and equipment	$8 to $15
Preparation of land	5 to 10
Manure or fertilizer	10 to 25
Plants	10 to 20
Setting plants	8 to 12
Cultivating and hoeing	20 to 35
Mulching	15 to 25
Total for growing the first year	76 to 142
Picking, grading, and packing 2,000 quarts	40 to 70
Crates and boxes	20 to 25
Hauling to station, etc	5 to 10
Total for picking, packing, grading, etc	65 to 105
Total for growing	76 to 142
Grand total	141 to 247

The lower estimate is about the average for most sections of the South, while the higher figures cover the extreme cost of production. The average cost in Florida is between these two, but nearer the higher estimate. It should be borne in mind that in these estimates the interest on the investment and all labor costs are included. Where the grower does not fertilize or mulch his crop the cost should be lower than given in the estimates. It is the farmer who secures more than the average yield who makes a success in growing strawberries, while those who produce less than the average for the region are losing money, if interest on the investment and the labor of the growers are considered. With a yield of 3,000 quarts to the acre, which is the average of many growers, there is a good profit in growing strawberries. Yields of 4,000 and 5,000 quarts to the acre are not uncommon.

When the plantation is kept for more than one year the cost of production is lowered, because there is no outlay for plants, preparation of the soil, or planting, as in the first year. The cost of fertiliz-

ing and cultivating an old plantation should be as much as for a new one. The average upkeep for the second year should not exceed $40 or $50 per acre.

STRAWBERRY BY-PRODUCTS.

Each year thousands of bushels of strawberries go to waste in the larger producing centers of the United States because of low prices or some adverse condition. In many regions of the South 20 to 25 per cent of the crop is never gathered, because the prices toward the end of the season are too low to justify picking the fruit. This is a great loss that should be avoided. With the increasing demand for strawberry products, such as crushed fruit, jellies, preserves, and marmalades, this loss can be greatly reduced.

Within the last few years some of the manufacturers of food products have been putting up fresh strawberries in large quantities for use at soda fountains and in the manufacture of ice cream. This industry can be developed into one of great importance to the producer, manufacturer, and consumer. Several large manufacturers buy surplus strawberries and put them up in the field, while others ship the fruit to their home factory. One of the best methods of handling the fruit is as follows: Wash the berries thoroughly in cold water, put them into tight barrels with sugar in about equal weights, load in refrigerator cars, and ship to a cold-storage plant where they can be held until needed. Sometimes the berries are crushed before being put into the barrels, but in most cases they are packed as nearly whole as possible. When ready for use they are taken from storage and manufactured into the various products. If the fruit is in good condition at the time it is placed in cold storage it can be kept for a long time without to any great extent losing its flavor and fresh color.

The keeping of strawberries under refrigeration is a comparatively new undertaking, but results that have been secured indicate that in time this can be made an important industry. It is possible to keep the fruit in such a way that its quality is practically unimpaired. In a single storage house that has come under the observation of the writer 6,000 barrels of crushed sugared strawberries were held at a temperature between 36° and 40° F. Proper storage is an important matter, for it will enable the grower to dispose of his surplus crop and at the same time will provide the consumer with a wholesome strawberry product throughout the year. When growers are banded together into a large association it often should be possible for them to manufacture strawberry by-products at the producing center under the management of the organization.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

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Contribution from the Bureau of Crop Estimates, Leon M. Estabrook, Chief.

THE AGRICULTURAL OUTLOOK.

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TIME OF ISSUANCE AND SCOPE OF APRIL CROP REPORT.

On Wednesday, April 7, at 12 noon (Washington time), the Bureau of Crop Estimates of the United States Department of Agriculture will issue a report upon the condition on April 1 of winter wheat and rye. Details by States, with comparisons, will appear in the April issue of the Agricultural Outlook. This number (April) of the Agricultural Outlook will also give estimates of the condition on April 1 and losses during the year from diseases of horses, cattle, sheep, and swine; losses from exposure of cattle and sheep; and the number of breeding sows on April 1, 1915, as compared with April 1, 1914, in percentages.

STOCKS OF GRAIN ON FARMS MARCH 1.

The Crop Reporting Board of the Bureau of Crop Estimates, from reports of correspondents and agents, estimates that the amount of wheat on farms March 1, 1915, was about 152,903,000 bushels, or 17.2 per cent, of the 1914 crop, against 151,809,000 bushels, or 19.9 per cent, of the 1913 crop on farms March 1, 1914, and 156,483,000 bushels, or 21.4 per cent, of the 1912 crop on farms March 1, 1913. About 60.7 per cent of the crop will be shipped out of the counties where grown, against 53.9 per cent of the 1913 crop and 61.6 per cent of the 1912 crop so shipped.

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The amount of corn on farms March 1, 1915, was about 910,894,000 bushels, or 34.1 per cent, of the 1914 crop, against 866,392,000 bushels, or 35.4 per cent, of the 1913 crop on farms March 1, 1914, and 1,289,655,000 bushels, or 41.3 per cent, of the 1912 crop on farms March 1, 1913. About 18.6 per cent of the crop will be shipped out of the counties where grown, against 17.2 per cent of the 1913 crop and 21.8 per cent of the 1912 crop so shipped. The proportion of the 1914 crop which is merchantable is about 84.5 per cent, against 80.1 per cent of the 1913 crop and 85 per cent of the 1912 crop.

The amount of oats on farms March 1, 1915, was about 379,369,000 bushels, or 33.2 per cent, of the 1914 crop, against 419,476,000 bushels, or 37.4 per cent, of the 1913 crop on farms March 1, 1914, and 604,216,000 bushels, or 42.6 per cent, of the 1912 crop on farms March 1, 1913. About 29.4 per cent of the crop will be shipped out of the counties where grown, against 26.5 per cent of the 1913 crop and 30.9 per cent of the 1912 crop so shipped.

The amount of barley on farms March 1, 1915, was about 42,889,000 bushels, or 22 per cent, of the 1914 crop, against 44,126,000 bushels, or 24.8 per cent, of the 1913 crop on farms March 1, 1914, and 62,283,000 bushels, or 27.8 per cent, of the 1912 crop on farms March 1, 1913. About 45.1 per cent will be shipped out of the counties where grown, against 48.4 per cent of the 1913 crop and 53.7 per cent of the 1912 crop so shipped.

WHEAT SUPPLIES.

Long-established custom has fixed upon March 1 as the date for taking stock of supplies of grain in the country. The information is presumed to be a guide to farmers in deciding what and how much to plant in the spring, and to dealers is indicative of the amount that can safely be exported without encroaching too closely upon home needs before the next crop becomes available. The beginning of the crop season, for statistical calculations, is July 1.

The results of the inquiry into stocks of wheat in the United States on March 1 this year indicate that as compared with a year ago there are 1,000,000 bushels more on farms and about 8,000,000 bushels less in country mills and elevators; "visible stocks," that is stocks at points of accumulation, are about 7,000,000 bushels less; thus making a total reduction in apparent supplies of 14,000,000 bushels.

A year ago March 1, there was sufficient wheat to supply domestic needs for food and seed between March 1 and July 1, and, in addition, to have 36,000,000 bushels for export during the four months and about 76,000,000 bushels surplus to carry into the new year. In other words, March 1 a year ago there were apparently 112,000,000 bushels in excess of home requirements.

This year March 1, there is apparently 14,000,000 bushels less supplies than a year ago. Between March 1 and July 1 this year there is likely to be about 5,000,000 bushels more seed wheat needed than last year, and nearly 2,000,000 bushels would normally be allowed for the increased needs for food requirements resulting from the year's increase in population. On this basis of calculation there would appear to be on March 1 about 21,000,000 bushels less surplus than a year ago, when there was an apparent surplus of 112,000,000 bushels; that is, a present surplus of about 91,000,000 bushels for export in the four months March 1 to July 1 and carry-over. Several additional facts should be taken into consideration in connection with this subject of wheat supplies. The Bureau of Crop Estimates has not inquired into the stocks of flour; but it is believed that they do not show as much reduction as do wheat stocks. Also, the Southern States have greatly increased their wheat acreage, the crop of which will be marketable before July 1, and have the effect of increasing the available supplies between now and July 1.

The exports of wheat (including flour) during the four months March 1 to July 1 last year were 36,000,000 bushels, or 25 per cent of the year's exports; in the past five years the exports between March 1 and July 1 have averaged 26,000,000 bushels, or 25 per cent of the average yearly exports. It would appear, therefore, that the United States is able, by reducing its carry-over to a small amount, to export during the four months March 1 to July 1 this year twice the amount exported in the same period last year and treble the average of the past five years in the like period. It does not appear, however, that exportations at the same rate as during January and February can continue during the entire period without encroaching upon normal domestic requirements. In Table 1 are shown the exports monthly of wheat (including flour) during the past five years:

TABLE 1.—*Exports of wheat (including flour) from the United States.*

[Compiled from the Monthly Summary of the Foreign Commerce of the United States.]

Month.	1914–15	1913–14	1912–13	1911–12	1910–11	1909–10
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	30,173,618	12,966,596	3,008,397	6,275,372	3,132,366	4,628,890
August	27,617,655	28,348,281	8,910,696	10,175,683	4,948,473	8,835,360
September	31,435,600	17,512,665	16,987,254	10,700,095	6,184,791	12,471,736
October	25,664,458	13,110,946	20,746,157	8,823,222	7,450,882	13,897,595
November	25,896,525	9,616,645	16,153,840	6,576,086	6,755,019	12,995,776
December	37,117,984	10,620,644	14,488,134	7,981,467	8,042,903	9,126,097
January	32,027,259	9,704,617	13,445,373	5,815,887	7,000,665	4,973,345
February	[1]35,500,000	7,554,992	9,193,876	5,030,888	5,128,078	3,527,335
Total, 8 months	[1]245,433,099	109,435,386	102,933,727	61,379,200	48,643,177	70,456,134
March	.....	6,954,128	8,799,485	5,853,254	5,616,730	3,737,356
April	.....	7,039,778	10,819,336	4,922,964	5,241,573	5,330,616
May	.....	10,915,044	11,177,828	4,385,436	5,851,934	4,975,991
June	.....	11,247,296	9,149,222	3,148,550	3,958,345	2,864,218
Total, 4 months	.....	36,156,246	39,945,871	18,310,204	20,668,582	16,908,181
Total, 12 months	.....	145,591,632	142,879,598	79,689,404	69,311,759	87,364,315
Per cent in first 8 months	.....	75.2	72.0	77.0	70.0	80.6
Per cent in last 4 months	.....	24.8	28.0	23.0	30.0	19.4

[1] Preliminary estimate.

SPRING WHEAT PRODUCTION, BY VARIETIES.

The most profitable variety of spring wheat grown last year was durum wheat, according to an investigation made by the Bureau of Crop Estimates. In yield per acre the Marquis led, but the higher prices paid for durum made its value per acre slightly higher than that of Marquis wheat.

The total production of durum wheat in Minnesota, North Dakota, and South Dakota (which produced 95 per cent of all durum wheat in the census year of 1909) was about 18,103,000 bushels in 1914, as compared with 21,529,000 in 1913. Durum wheat represented 11.6 per cent of all spring wheat raised in these States in 1914 compared with 13.5 per cent in 1913.

In former years an obstacle to the growing of durum wheat was the low price offered for it. For instance, in the census production year 1909 durum yielded two bushels per acre more than common varieties of spring wheat, but it sold for 17 cents per bushel less, consequently it was less profitable.

This year, however, the price of durum has been higher than that of all other varieties, being about $1.27 per bushel in the middle of January, as compared with about $1.15 for common varieties; hence, on this basis, the value per acre was $16.09, as compared with $11.79 for common varieties.

TABLE 2.—*Estimated production in 1914 of the different varieties of wheat in the three spring wheat States.*

Variety.	Total.		Minnesota.		North Dakota.		South Dakota.	
	Bushels.	Per cent.	Bushels.	Per cent.	Bushels.	Per cent.	Bushels.	Per cent.
Blue Stem	68,023,000	43	22,240,000	52	36,395,000	45	9,388,000	30
Velvet Chaff	32,297,000	21	12,984,000	30	9,425,000	11	9,888,000	31
Fife	23,765,000	15	2,715,000	7	17,549,000	21	3,501,000	11
Durum	18,103,000	12	990,000	2	10,389,000	13	6,724,000	21
Marquis	6,360,000	4	1,349,000	3	4,111,000	5	900,000	3
Winter	2,011,000	1	975,000	2	70,000	.....	966,000	3
Other or uncertain	5,584,000	4	1,722,000	4	3,653,000	4	199,000	1
Total	156,143,000	100	42,975,000	100	81,592,000	100	31,566,000	100

TABLE 3.—*Estimated yield per acre in 1914, average price per bushel in the middle of January, 1915, and value per acre of the several varieties of wheat in the three spring wheat States.*

Variety.	Minnesota.			North Dakota.			South Dakota.		
	Yield per acre.	Price per bu.	Value per acre.	Yield per acre.	Price per bu.	Value per acre.	Yield per acre.	Price per bu.	Value per acre.
	Bu.			*Bu.*			*Bu.*		
Blue Stem	9.8	$1.15	$11.27	10.3	$1.16	$11.95	7.5	$1.10	$8.25
Velvet Chaff	11.6	1.15	13.34	12.1	1.16	14.01	9.3	1.10	10.23
Fife	10.3	1.18	12.15	10.9	1.17	12.75	9.3	1.12	10.42
Durum	12.3	1.24	15.25	13.9	1.29	17.93	11.2	1.24	13.89
Marquis	12.8	1.17	14.98	14.9	1.18	17.58	11.2	1.17	13.10
Winter	19.5	1.15	22.42	13.7	1.16	15.89	14.0	1.09	15.26
Other or uncertain	11.0	1.15	12.65	10.8	1.11	11.99	8.7	1.13	9.83
Average	10.6	1.155	12.25	11.2	1.177	13.19	9.1	1.134	10.32

FLORIDA AND CALIFORNIA CROP REPORT.

TABLE 4.—*Crop situation in Florida and California, Mar. 1, 1915, with comparisons.*

Item.	Florida.			California.		
	1915	1914	1913	1915	1914	1913
Orange trees (condition)	92	94	93	98	90	68
Lemon trees (condition)	.....	.....	.....	97	85	56
Lime trees (condition)	90	97	96	.....	.....	.....
Grapefruit trees (condition)	93	96	92	.....	.....	.....
Pineapple plants (condition)	86	90	92	.....	.....	.....
Tomatoes (condition)	65	85	84	.....	.....	.....
Cabbages (condition)	85	88	91	.....	.....	.....
Celery (condition)	.....	.....	.....	91	94	82
Cauliflower (condition)	.....	.....	.....	94	94	85
White potatoes[1] (condition)	89	88	93	.....	.....	.....
Spring pasture (condition)	82	87	86	.....	.....	.....
Spring plowing (per cent done)	75	68	75	.....	.....	.....
Spring planting (per cent done)	45	52	56	.....	.....	.....
Meadows (condition)	85	90	93	.....	.....	.....

[1] The acreage planted to white potatoes is about 10 per cent lower than last year's acreage.

THE HAWAIIAN SUGAR CROP, 1913-14.

The sugar produced in Hawaii during the year ending June 30, 1914, equaled 612,000 short tons, and was the largest ever recorded for that Territory. While the acreage was less than in the three previous years, the average yield of cane per acre was the highest and so was the sugar yield per acre of cane. An average of 45 tons of cane per acre was harvested, and 240 pounds of sugar were made on an average, from each ton of cane. Details are shown in Table 5.

Since 18 months are required for a crop to mature, only a part, possibly one-half, of the total cane acreage is actually harvested during one season. Ten plantations reported in 1913–14 a total cane area of 39,580 acres, of which 20,755 acres, or 52 per cent, were harvested during the year.

TABLE 5.—*The Hawaiian sugar campaigns ending Sept. 30, 1912–1914.*

[Figures for 1914 are subject to revision.]

Island and year ending Sept. 30—	Factories in operation.	Average length of campaign.	Sugar made.	Cane used for sugar.			Average extraction of sugar.		
				Area harvested.	Average yield per acre.	Production (cane crushed).	Per cent of cane.	Per short ton of cane.	Per acre of harvested cane.
	Number.	*Days.*	*Short tons.*	*Acres.*	*Short tons.*	*Short tons.*	*Per cent.*	*Pounds.*	*Pounds.*
Hawaii:									
1914	23	174	213,000	51,000	36	1,854,000	11.49	230	8,353
1913	24	170	197,212	53,600	32	1,703,000	11.58	232	7,364
1912	24	204	208,914	52,900	34	1,799,000	11.67	233	7,936
Kauai:									
1914	9	214	121,000	21,800	50	1,089,000	11.11	222	11,204
1913	9	198	100,340	20,800	42	841,000	11.93	239	9,665
1912	9	206	96,845	18,900	43	807,000	12.00	240	10,248
Maui:									
1914	7	167	145,000	19,400	54	1,054,000	13.76	275	14,948
1913	7	182	124,320	19,700	47	929,000	13.44	269	12,684
1912	7	192	148,740	19,400	55	1,074,000	13.85	277	15,334
Oahu:									
1914	7	188	133,000	20,700	53	1,097,000	12.12	242	12,850
1913	10	157	124,152	20,500	49	1,003,000	12.38	248	12,153
1912	10	200	139,539	21,860	50	1,094,000	12.75	255	12,802
Territory of Hawaii:									
1914	46	183	612,000	112,700	45	5,094,000	12.01	240	10,861
1913	50	169	546,524	114,600	39	4,476,000	12.21	244	9,544
1912	50	200	595,038	113,000	42	4,774,000	12.46	249	10,532

INTERNATIONAL INSTITUTE CROP REPORT.

Reports to the International Institute of Agriculture from seven countries show a total area sown to winter wheat, in the autumn of 1914, of 85,600,000 acres, or 14 per cent more than was sown in 1913. The countries included in this report are British India, Canada, Denmark, England and Wales, Italy, Luxemburg, Switzerland, and the United States.

The production of wheat in 1914–15 in Argentina, Chile, and Australia is reported by the International Institute as 246,000,000 bushels; in 1913–14 these crops equaled 230,000,000 bushels. An abnormally small crop in Australia in 1914–15 (only 28.5 per cent of the 1913–14 crop) was more than compensated by good crops in Argentina and Chile, leaving a net increase in the three countries in 1914–15 of 7 per cent over 1913–14.

TREND OF PRICES OF FARM PRODUCTS.

The level of prices paid producers of the United States for the principal crops increased about 2.5 per cent during February; in the past seven years the price level has increased during February 1.6 per cent.

On March 1 the index figure of crop prices was about 7.6 per cent higher than a year ago, 27.1 per cent higher than two years ago, and

12.0 per cent higher than the average of the past seven years on March 1.

The level of prices paid to producers of the United States for meat animals decreased 1.7 per cent during the month from January 15 to February 15. This compares with an average increase from January 15 to February 15 in the past five years of 1.4 per cent.

On February 15 the average (weighted) price of meat animals—hogs, cattle, sheep, and chickens—was $6.46 per 100 pounds, which compares with $7.27 a year ago, $6.70 two years ago, $5.54 three years ago, $6.19 four years ago, and $6.71 five years ago on February 15.

A tabulation of prices is shown in Tables 12 to 15.

STOCKS OF WOOL IN MANUFACTURERS' HANDS.

The first inquiry made by the Department of Agriculture as to stocks of wool held by manufacturers on January 1 resulted in replies from manufacturers whose total purchases in 1914 amounted to 158,169,000 pounds of wool (raw equivalent). Their stocks on January 1, 1915, amounted to 39,995,000 pounds, which equals 25.3 per cent of their purchases last year. Their stocks on January 1, 1914, were 22,933,000 pounds. The manufacturers reporting had, therefore, in the aggregate, nearly 75 per cent more wool on January 1, 1915, than on January 1, 1914.

TIME OF TRANSIT TO ENGLAND THROUGH PANAMA CANAL.

The average time of transit for steamships from United States Pacific coast ports to England is about one-half what it was before the opening of the Panama Canal. Grain ships arriving at British ports from August, 1914, to February 13, 1915, from San Francisco, Portland, Oreg., and Puget Sound averaged 48 days for a voyage. Of 27 voyages, the shortest was 34 days and the longest 88. Only 3, however, exceeded 54 days.

Most of the grain exported from the Pacific coast is carried in steamships this season (1914–15). Last season (1913–14) most of the export grain from the Pacific coast was carried in sail vessels, whose voyages to British ports averaged 136 days. Of 22 cargoes, the shortest time of transit was 102 days and the longest 171 days. In 1913–14 the average time of transit for steamships carrying grain over these routes was 94 days, or nearly double the average for the first part of 1914–15.

COUNTRIES PROHIBITING CEREAL EXPORTS.

Exports of various articles of food have been prohibited by many countries since the outbreak of the present European war. The International Institute of Agriculture gives the following list of countries from which it is forbidden to export certain articles:

Cereals generally are forbidden to be shipped out of Austria-Hungary, Belgium, Bulgaria, Denmark, France, Germany, Great Britain and Ireland, Italy, Netherlands, Roumania, Sweden, Switzerland, Egypt, Tunis, Union of South Africa, Australia (except to Great Britain and Ireland), New Zealand, and, to some extent, out of Canada and Russia. The regulations of some of the countries differ as to what cereals are prohibited, what countries of destination are affected, and as to other details.

Great Britain and Ireland, also Switzerland, prohibit the export of all foodstuffs.

WAGES OF FARM LABOR.

The money wages of farm labor averaged during the past year about 1.7 per cent lower than during the preceding year, but about 9 per cent higher than five years ago.

The wages per month without board averaged, for the United States, $29.88 during the past year, which compares with $30.31 in the preceding year, $27.43 five years ago, and $19.97 fifteen years ago. State averages last year ranged from $16.50 in South Carolina to $56 in Nevada.

Wages per month, including board, averaged $21.05, compared with $21.38 in the preceding year, $20.01 five years ago, and $13.90 fifteen years ago. State averages last year ranged from $12 in South Carolina to $39 in Nevada.

Day labor other than harvest, without board, averaged $1.45 a day, compared with $1.50 the preceding year and $1.29 five years ago. State averages ranged from $0.82 in South Carolina to $2.54 in Montana.

Day labor other than harvest, with board, averaged $1.13, compared with $1.16 a year ago and $1.03 five years ago. State averages ranged from $0.64 in South Carolina to $1.80 in Montana.

Day labor at harvest time, without board, averaged $1.91, compared with $1.94 a year ago and $1.71 five years ago. State averages ranged from $1.06 in Mississippi to $3.25 in North Dakota.

Day labor at harvest time, with board, averaged $1.55, compared with $1.57 a year ago and $1.43 five years ago. State averages ranged from $0.82 in Mississippi to $2.68 in North Dakota.

The reductions in wages as compared with the preceding year were greatest in the Southern States, due largely to the depression in the cotton market; but all sections showed some reduction, although a few States showed slight advances in some kinds of employment.

FARM LABOR EMPLOYMENT SERVICE.

A system of distribution of wage earners, established by the Department of Labor of the United States, is now in operation and prepared to receive applications for help, skilled and unskilled. On January 22 the Department of Labor published the following notice:

TO WHOM IT MAY CONCERN: The Department of Labor, through the Division of Information of the Bureau of Immigration, has recently established distribution branches throughout the country for the purpose on the one hand of developing the welfare of the wage earners of the United States and improving their opportunities for profitable employment, and on the other hand of affording to employers a method whereby they may make application for such help as they need, either male or female, citizens or alien residents, and have their wants supplied through said distribution branches. No fee is charged employer or employee for this service.

The Post Office Department and the Department of Agriculture are cooperating with the Department of Labor in this work. The plan provides for placing in every post office in the United States the blanks of the Division of Information, so that persons seeking employment and employers in need of help may apply at their local post offices for the appropriate blanks on which to make application.

Realizing that the distribution of these blanks in this way will in all probability result in the filing of many applications for employment, it has been deemed advisable to communicate directly with industrial establishments, farmers, and other employers of labor, for the purpose of securing profitable employment for applicants.

There is accordingly sent you herewith a form of application which, in the event of your needing help, may be filled out and returned in the accompanying envelope without postage. Careful attention will be given to the selection of applicants with a view to directing to employers only such help as is specified in the applications received.

If you are not in need of help—skilled or unskilled—at the present time the inclosed blank may be retained for future use.

(Signed) W. B. WILSON, *Secretary.*

The cooperation by the Department of Agriculture, referred to above, does not involve more than giving wide publicity among farmers to the service undertaken by the Department of Labor.

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If a farmer wishes to hire some farm laborers he can secure an application blank from his nearest post office. The following is a form of such blank:

FOR USE IN MAKING APPLICATION FOR FARM HELP.

U. S. DEPARTMENT OF LABOR.

BUREAU OF IMMIGRATION, DIVISION OF INFORMATION, WASHINGTON.

Division No.....
Branch No..... (FARM LABORERS.)

Read carefully notations on back hereof before attempting to fill out this blank. Write name and address plainly.

Date.....

1. Employer:.....(Name.)Post office.....
   County of.....State of.....
   Telegraph office.....Railroad station.....
2. References:.....
3. Number of men you wish to hire:.....
4. (*a*) Nature of duties:.....(State whether truck farm, stock farm, or dairy.)
   (*b*) State number of cows each man must milk:.....
5. (*a*) Nationalities acceptable:.....(State whether or not knowledge of English is necessary.)
   (*b*) Will English-speaking men of any other nationality be acceptable?.....
   (*c*) Do you desire experienced help or "green hands"?.....
6. (*a*) Married or single men preferred:.....
   (*b*) Do you require that married men be accompanied by wives?.....
   (*c*) Will children be objectionable?.....
7. (*a*) Will you advance transportation from points within the United States?.....
   (*b*) If so, will amount be deducted later from employee's wages?.....
   (*c*) Will you refund the money so deducted after a period of service, and, if so, under what conditions?.....
8. (*a*) What money wage will you pay married man. { green hand? $..... (Winter.) $..... (Summer.) per month; experienced hand? $..... (Winter.) $..... (Summer.) per month; }
   and will house (furnished or unfurnished), garden patch, fuel, milk, etc., be provided free in addition to wages?.....
   (*b*) Would services of wife be required, and, if so, her duties and compensation therefor?.....
   (*c*) What wages will you pay single man..... { green hand? $..... (Winter.) $..... (Summer.) per month; experienced hand? $..... (Winter.) $..... (Summer.) per month; }
   and will board, lodging, washing, etc., be furnished free in addition to wages? ..... (Yes or no.)
   (*d*) Winter pay ..... (Date.) to ..... (Date.) Summer pay ..... (Date.) to..... (Date.)
9. When will services of this help be required?.....(State day and month when you desire help to arrive.)
10. Hours of labor:.....
11. Will employment be permanent?.....
12. Size of farm or place, ... (Acres.) Under cultivation, ... (Acres.) Number of men on place, ...

13. Do you employ extra hands for any part of the year; if so, how many; for what kind of work; at what pay; when, and for how long a period of time?

.....

14. Remarks: .....

It is agreed that the undersigned will keep the division informed as to need of men applied for above, and advise by telegraph (at employer's expense) in case said help is secured through other sources; this in order that men may not be directed and find position filled upon arrival.

(Sign here).....

(NOTE.—Additional sheets may be used if necessary.)

READ CAREFULLY BEFORE FILLING OUT BLANK.

☞ **N. B.—The party filling out this blank may return same to the postmaster or transmit same through the rural mail carrier or through the officer in charge of any branch post office, whereupon it will be forwarded to destination free of charge for postage. If transmitted otherwise the usual postage will be required.**

In addition to answering carefully all the questions on this blank, your especial attention is called to the following:

QUESTION 4. **Nature of duties.**—Define whether a "farmer" or a "farm laborer" is wanted. A "farmer" will be understood to mean one who is competent to take charge of and operate a farm without supervision. A "farm laborer" will be understood to mean one who has had some experience, but is to work under the immediate direction and supervision of the employer. If a "green hand" (one who has had no experience at farm work, but willing to learn) will be accepted as a farm laborer, it should be so stated. Also make it clear whether you operate a "dairy farm," "stock farm," "truck farm," etc. If immigrant help is acceptable, so state. "Experienced" are those with experience in native land, or in the United States; "green," those with no farming experience.

QUESTION 5. **Nationalities preferred.**—As much scope as possible should be allowed in the matter of nationalities which would be acceptable to you. Always state whether or not a knowledge of English is necessary.

QUESTION 6. **Married or single men preferred.**—If your preference be for a man and wife, state whether or not a single man will answer, provided we are unable to supply the married couples. This is asked because at times there is a scarcity of the latter.

QUESTION 7. **Will you advance transportation from points within United States?**—*The necessity for this question is due to the fact that many good men apply at our branch offices who would willingly go to distant points, but are unable to do so without aid from the prospective employer. Such advance would, of course, be made through a representative of this division, who would see that the employee was properly ticketed and then mail his baggage check direct to the employer interested, which would serve somewhat as a precaution against an employee going astray.*

It must be distinctly understood, however, that the responsibility of the division and its representative ends when the said employee has been placed upon the train or boat. No guaranty is given or implied that he will actually arrive at his destination. (See circular on this subject.)

QUESTION 8. **Wages.**—This question must not be left unanswered, because of the fact that an employee wants to know as to the wages he is to receive before accepting an offer, and this point should be definitely stated. If wages are stated at so much per day, it should be made clear whether employee is paid for *every* day in the month or only for such days as work can be performed. Also approximate pay received per week or month in such case.

All communications relative hereto should be addressed:

DIVISION OF INFORMATION,
BUREAU OF IMMIGRATION, DEPARTMENT OF LABOR,
WASHINGTON, D. C.

THIS SERVICE IS FREE TO EMPLOYER AND EMPLOYEE.

Persons who wish employment on a farm can secure from any post office an application blank, as shown below:

APPLICATION FOR EMPLOYMENT.

U. S. DEPARTMENT OF LABOR, BUREAU OF IMMIGRATION, DIVISION OF INFORMATION, WASHINGTON.

When you shall have filled out this blank please return same to the postmaster, or transmit same through the rural mail carrier or through the officer in charge of any branch post office, whereupon it will be forwarded to the proper officer of the Department of Labor for action. No postage necessary when thus returned. If transmitted otherwise the usual postage will be required. You will be notified when work of the kind desired is available. This service is FREE.

T. V. POWDERLY,
Chief of Division.

Date.....

Name and address.....

Age.... Height.... feet.... inches. Weight.... pounds. Sex..... Race.....

Where born (name of country).....

If of *foreign birth*, how many years have you been in the United States?.....

Trade or calling..... Experience.....

Wages expected ..... Other work will be accepted as.....

Wages expected ..... What experience have you had in this other work?

..... Are you a citizen of the United States?.....

If married, names of wife or husband and children.....

.....

Will family accompany you (yes or no)?..... If so, is wife able and willing to accept employment as domestic?

How much money would you pay for railroad tickets? .....

What languages do you speak?.....

Name and address of last employer.....

Wages received ..... Cause of loss of position.....

Name and address of one other employer.....

Wages received ..... Cause of loss of position.....

Are you strong and robust (yes or no)? ..... If you have any ailment or physical disability, state just what it is.....

How long have you been idle?..... In what States will you accept employment? .....

If you are a farm hand, state kind of farming you have done, where service was performed, and the number of cows you can milk .....

.....

(Sign here) .....

U. S. DEPARTMENT OF LABOR, BUREAU OF IMMIGRATION, DIVISION OF INFORMATION, WASHINGTON, D. C.

Address list of distribution branches, showing territory controlled by each.

[Address all communications as follows: "Distribution Branch, U. S. Immigration Service" (at the address shown below).]

Zone No.	Location of branch.	Local address.	States or territory controlled.
1	Boston, Mass.	Long Wharf.	Maine, Massachusetts, Rhode Island.
2	New York, N. Y.	U. S. Barge Office.	New York, New Jersey, Connecticut, New Hampshire, Vermont.
3	Philadelphia, Pa.	Gloucester City, N. J.	Pennsylvania, Delaware, West Virginia.
4	Baltimore, Md.	Stewart Building.	Maryland.
5	Norfolk, Va.	119 West Main Street.	Virginia, North Carolina.
6	Jacksonville, Fla.	Federal Building.	Florida, Georgia, Alabama, South Carolina.
7	New Orleans, La.	Immigration Station.	Louisiana, Mississippi, Arkansas, Tennessee.
8	Galveston, Tex.	do.	Texas, New Mexico.
9	Cleveland, Ohio.	Post-Office Building.	Ohio, Kentucky.
10	Chicago, Ill.	845 South Wabash Avenue.	Illinois, Indiana, Michigan, Wisconsin.
11	Minneapolis, Minn.	Federal Building.	Minnesota, North Dakota, South Dakota.
12	St. Louis, Mo.	Chemical Building.	Missouri, Kansas, Oklahoma, Iowa.
13	Denver, Colo.	Central Savings Bank Building.	Colorado, Wyoming, Nebraska, Utah.
14	Helena, Mont.	Power Building.	Montana, Idaho.
15	Seattle, Wash.	Fifteenth Avenue West and Main Street.	Washington.
16	Portland, Oreg.	Railway Exchange Building	Oregon.
17	San Francisco, Cal.	Angel Island.	California, north of the northern boundary of San Luis Obispo, Kern, and San Bernardino Counties; also State of Nevada.
18	Los Angeles, Cal.	Post-Office Building.	California, south of the northern boundary of San Luis Obispo, Kern, and San Bernardino Counties; also State of Arizona.

A. CAMINETTI,
Commissioner General of Immigration.

JANUARY 4, 1915.
Reserve this list for reference.

APPLES IN COLD STORAGE MARCH 1, 1915, AND PROGRESS OF MOVEMENT.

Contribution from the Office of Markets and Rural Organization.

Reports as of March 1, 1915, have been received from 289 cold storages having an approximate capacity of 7,074,580 barrels, showing the quantity of barreled and boxed apples held by them on that date. The following statement is for these 289 cold storages, March 1, 1915:

289 cold storages.	Barrels.	Boxes.	Equivalent in barrels.
In storage Mar. 1, 1915.	1,378,874	1,730,662	1,955,761

Of the 289 storages reporting on March 1, 216, having an approximate capacity of 5,809,431 barrels, reported their holdings on March 1, 1913. Their holdings were as follows:

216 cold storages.	Barrels.	Boxes.	Equivalent in barrels.
In storage Mar. 1, 1913	1,045,249	1,784,312	1,640,020
In storage Mar. 1, 1915	1,026,397	1,561,375	1,546,855

From the above it appears that there were 5.7 per cent less apples in storage in these houses on March 1, 1915, than on March 1, 1913.

Of the 289 storages reporting for March 1, only 221, having an approximate capacity of 5,657,209 barrels, reported on February 1. Their holdings on these dates were as follows:

221 cold storages.	Barrels.	Boxes.	Equivalent in barrels.
In storage Feb. 1, 1915	1,588,425	2,158,759	2,308,011
In storage Mar. 1, 1915	1,086,820	1,533,952	1,598,137

The decrease during February, 1915, is 501,605 barrels and 624,807 boxes, which is equivalent to 709,874 barrels.

This is a decrease of 31.6 per cent in barreled apples and 28.9 per cent in boxed apples, or a total of 30.8 per cent of all apples in storage February 1, 1915.

Of the 289 storages reporting for March 1, only 165, having an approximate capacity of 4,000,350 barrels, reported on December 1, January 1, and February 1. Their holdings on these dates were as follows:

165 cold storages.	Barrels.	Boxes.	Equivalent in barrels.
In storage Dec. 1, 1914	1,676,909	2,202,011	2,410,913
In storage Jan. 1, 1915	1,539,127	2,055,537	2,224,306
In storage Feb. 1, 1915	1,247,783	1,827,922	1,857,090
In storage Mar. 1, 1915	878,059	1,313,611	1,315,929

These 165 firms show a decrease during December, 1914, of 8.2 per cent in barreled apples and 6.7 per cent in boxed apples, or a total decrease of 7.7 per cent.

During January, 1915, the holdings of barreled apples decreased 17.4 per cent, of boxed apples 10.3 per cent, equivalent to a decrease of 15.2 per cent of the total holdings of December 1.

During February, 1915, the holdings of barreled apples decreased 22 per cent, of boxed apples 23.4 per cent, equivalent to a decrease of 22.4 per cent of the total holdings of December 1.

During the months of December, 1914, January, 1915, and February, 1915, taken together, the decrease was 47.6 per cent in barreled apples, and 40.3 per cent in boxed apples, or a total decrease of 45.4 per cent since December 1, 1914.

This office will endeavor to issue on the 10th of next month a similar statement for the month of March.

STOCKS OF CEREALS AND AGGREGATE VALUE PER ACRE OF CROP PRODUCTION.

TABLE 6.—*Wheat: Estimated stocks on farms and in interior mills and elevators, price per bushel Mar. 1, 1915, and percentage of crop which moved out of county where grown, by States, with comparisons.*

State.	Per cent of crop on farms Mar. 1.			Quantity on farms Mar. 1, in thousands of bushels.			Per cent of crop shipped out of county where grown.			Quantity in interior mills and elevators Mar. 1, in thousands of bushels.			Price per bushel to producers Mar. 1.		
	1915	1914	10-year average.	1915	1914	5-year average.	1915	1914	10-year average.	1915	1914 (revised).	1913 (revised).	1915	1914	5-year average.
	P.c.	*P.c.*	*P.c.*	*Bu.*	*Bu.*	*Bu.*	*P.c.*	*P.c.*	*P.c.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Cts.*
Maine	30	35	33	24	35	31	1	0	0	(1)	(1)	(1)			
Vermont	30	12	30	9	3	6	0	0	0	(1)	(1)	(1)	130	100	102
New York	23	25	27	1,863	1,700	1,861	29	31	24	972	612	536	145	97	100
New Jersey	18	21	25	256	294	370	22	30	27	(1)	(1)	(1)	144	94	100
Pennsylvania	23	30	34	5,462	6,570	6,909	35	32	29	3,800	3,935	3,571	142	95	100
Delaware	20	21	25	467	336	399	61	53	55	(1)	(1)	(1)	145	98	100
Maryland	18	16	22	2,368	1,296	1,985	62	56	61	1,184	1,136	898	148	95	100
Virginia	23	22	27	2,398	2,332	2,396	33	32	31	1,581	1,591	1,547	142	100	105
West Virginia	24	27	28	850	810	749	10	12	16	(1)	(1)	(1)	144	101	105
North Carolina	29	28	30	2,126	1,988	1,688	7	4	5	(1)	(1)	(1)	150	110	113
South Carolina	17	20	22	156	200	168	2	1	2	(1)	(1)	(1)	146	124	121
Georgia	20	22	22	339	374	287	5	6	4	(1)	(1)	(1)	146	117	124
Ohio	22	28	28	8,038	9,828	8,113	50	44	44	4,019	4,212	1,464	141	92	99
Indiana	15	20	21	6,496	7,960	6,485	58	52	50	5,189	4,773	1,210	142	91	97
Illinois	12	17	19	5,550	7,123	6,197	57	53	54	3,700	3,770	982	134	87	94
Michigan	23	26	26	3,983	3,328	3,903	49	40	41	2,078	1,789	980	139	92	96
Wisconsin	25	36	32	878	1,332	1,092	25	24	18	351	476	463	132	83	90
Minnesota	24	29	28	10,314	19,720	17,504	65	59	66	4,298	8,845	10,726	126	83	90
Iowa	20	26	31	3,013	4,264	3,586	70	58	42	1,205	1,312	1,928	137	79	85
Missouri	16	17	19	6,933	6,732	5,564	50	43	48	5,200	5,542	4,275	137	87	94
North Dakota	19	19	23	15,502	14,991	19,969	70	68	74	6,527	8,674	24,449	134	80	86
South Dakota	22	27	25	6,945	9,180	9,969	67	65	71	4,104	5,096	8,350	128	78	85
Nebraska	16	22	26	10,899	13,706	12,365	70	62	66	4,087	5,609	4,955	131	74	81
Kansas	17	12	18	30,124	10,440	12,585	72	54	69	8,860	6,089	8,306	133	79	87
Kentucky	10	13	17	1,254	1,287	1,390	34	25	31	2,633	1,972	1,166	142	97	100
Tennessee	16	16	20	1,786	1,344	1,470	30	28	30	1,562	1,428	920	143	103	107
Alabama	14	15	17	56	60	40	3	3	3	(1)	(1)	(1)	130	122	117
Mississippi	2		13	0	0	13	3	0	0					100	110
Texas	11	10	11	1,547	1,360	966	48	48	34	1,969	2,320	1,764	139	90	101
Oklahoma	10	8	14	4,798	1,400	2,108	76	60	61	4,798	1,575	3,215	130	80	90
Arkansas	17	24	22	276	312	219	14	14	9	(1)	(1)	(1)	133	87	95
Montana	19	23	28	3,488	4,761	3,431	55	55	41	(1)	(1)	(1)	120	65	77
Wyoming	20	31	32	458	682	516	17	25	11	(1)	(1)	(1)	116	73	92
Colorado	18	24	24	2,036	2,328	2,194	59	55	50	(1)	(1)	(1)	120	75	81
New Mexico	21	15	20	386	180	173	20	15	9	(1)	(1)	(1)	112	92	102
Arizona	6	12	14	52	108	77	8	10	8	(1)	(1)	(1)	135	100	108
Utah	23	28	33	1,673	1,792	1,568	35	28	35	(1)	(1)	(1)	121	75	80
Nevada	16	28	27	213	308	262	28	20	16	(1)	(1)	(1)	135	91	101
Idaho	17	19	22	2,442	2,679	2,883	60	54	63	(1)	(1)	(1)	122	67	74
Washington	12	12	15	5,021	6,396	6,337	70	75	77	6,694	9,594	16,118	128	77	80
Oregon	11	11	15	1,826	1,727	2,087	58	58	59	(1)	(1)	(1)	128	80	83
California	6	13	11	408	546	735	60	45	59	(1)	(1)	(1)	131	96	96
United States	17.2	19.9	22.6	152,903	151,812	150,650	60.7	53.9	57.7	85,955	93,626	118,400	133.6	83.1	89.0

[1] Not estimated separately, but included in total.

TABLE 7.—*Corn: Estimated stocks on farms, price per bushel Mar. 1, 1915, percentage of crop which moved out of county where grown, and percentage of crop which is of merchantable quality, by States, with comparisons.*

State.	Per cent of crop on farms Mar. 1.			Quantity on farms Mar. 1, in thousands of bushels.			Per cent of crop shipped out of county where grown.			Per cent of crop merchantable.			Price per bushel to producers Mar. 1.		
	1915	1914	10-year average.	1915	1914	5-year average.	1915	1914	10-year average.	1915	1914	10-year average.	1915	1914	5-year average.
	P.c.	*P.c.*	*P.c.*	*Bush.*	*Bush.*	*Bush.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*P.c.*	*Cts.*	*Cts.*	*Cts.*
Maine	17	17	21	125	102	151	1	0	0	77	65	79	89	85	76
New Hampshire	18	21	26	174	168	279	0	1	0	75	64	78	86	80	73
Vermont	20	24	28	423	408	532	0	0	0	68	61	75	84	74	70
Massachusetts	27	28	31	609	532	657	0	1	1	80	72	80	81	79	74
Rhode Island	35	47	40	162	188	189	2	1	1	84	71	82	104	....	89
Connecticut	26	30	31	730	690	898	0	0	1	83	73	83	92	77	74
New York	27	23	29	6,088	3,450	5,559	2	2	2	77	59	72	90	80	71
New Jersey	43	44	42	4,503	4,796	4,152	12	15	16	89	88	88	80	77	70
Pennsylvania	35	38	37	21,762	21,698	20,352	9	7	7	88	83	80	83	71	68
Delaware	46	43	44	3,262	2,666	2,438	32	35	37	88	85	87	73	70	63
Maryland	44	42	43	10,794	9,282	9,143	25	20	28	87	80	84	86	68	65
Virginia	39	44	44	15,358	22,660	19,489	7	8	10	81	84	84	93	83	76
West Virginia	30	33	33	6,808	7,491	6,153	4	4	5	82	81	78	93	86	77
North Carolina	48	48	46	27,624	26,544	21,980	4	3	4	86	87	86	94	93	87
South Carolina	49	53	51	17,904	20,405	16,427	3	2	3	90	91	90	97	101	93
Georgia	52	53	47	29,120	33,390	24,755	3	6	3	88	90	89	93	93	87
Florida	31	42	39	3,472	4,242	3,315	5	4	2	83	88	85	89	81	86
Ohio	32	37	38	45,669	54,131	60,584	20	23	24	86	81	82	73	63	57
Indiana	36	37	40	58,794	65,268	74,267	25	29	32	87	84	84	70	61	53
Illinois	33	36	42	99,011	101,592	150,043	34	35	44	85	75	87	68	60	53
Michigan	31	32	34	19,530	17,952	18,413	6	5	5	83	78	73	73	66	59
Wisconsin	27	37	32	18,863	24,716	18,719	4	5	3	82	78	75	71	59	56
Minnesota	29	35	34	26,390	33,600	27,233	26	25	16	88	85	73	62	50	47
Iowa	36	37	43	140,193	125,171	147,296	34	30	26	93	90	86	65	56	48
Missouri	24	22	36	38,016	28,402	71,309	6	5	11	66	56	81	76	72	59
North Dakota	19	20	20	2,660	2,160	1,412	3	3	2	76	68	66	67	57	57
South Dakota	30	31	35	23,400	20,863	19,165	30	35	28	93	89	82	62	54	47
Nebraska	41	24	40	71,320	27,408	64,336	29	15	35	93	83	90	64	60	49
Kansas	27	6	31	29,221	1,404	44,495	12	1	20	83	45	83	74	71	57
Kentucky	38	34	40	34,675	25,432	35,298	6	5	10	73	75	82	77	79	69
Tennessee	41	42	42	32,964	28,854	33,758	11	9	15	81	81	86	81	82	71
Alabama	48	47	45	26,634	26,038	21,787	3	2	3	85	87	87	93	93	84
Mississippi	44	48	43	25,641	30,240	22,799	6	4	3	84	89	87	83	81	78
Louisiana	34	38	35	13,124	15,884	13,454	12	6	6	83	77	82	88	79	78
Texas	23	30	31	28,704	48,960	35,448	7	6	8	74	74	81	96	87	79
Oklahoma	20	18	30	10,000	9,396	19,154	12	12	24	75	65	79	83	75	63
Arkansas	27	36	38	11,340	16,920	18,217	3	3	3	82	79	82	93	82	75
Montana	15	28	19	210	252	120	3	3	2	80	85	82	87	....	96
Wyoming	10	17	18	52	85	55	1	1	0	78	78	73	85	75	62
Colorado	38	32	27	4,038	2,016	1,844	15	15	10	91	86	79	68	68	63
New Mexico	30	18	21	773	288	349	12	3	5	88	75	80	100	77	92
Arizona	15	16	18	86	80	73	4	10	6	85	75	84	92	108	110
Utah	15	16	20	63	48	49	2	3	4	78	80	75	....	74	77
Nevada	5	....	....	2	0	1	0	0	0	85	....	....	115	....	....
Idaho	13	10	15	77	40	42	2	3	2	80	87	88	80	73	74
Washington	17	15	16	165	150	133	5	5	4	80	78	82	98	71	79
Oregon	9	13	12	59	78	70	1	2	2	75	80	81	100	77	88
California	14	14	14	302	252	221	15	17	19	90	85	89	109	86	84
United States	34.1	35.4	39.1	910,894	866,392	1,036,611	18.6	17.2	21.7	84.5	80.1	84.2	75.1	69.1	60.5

TABLE 8.—*Oats: Estimated stocks on farms, price per bushel Mar. 1, 1915, and percentage of crop which moved out of county where grown, by States, with comparisons.*

State.	Per cent of crop on farms Mar. 1.			Quantity on farms Mar. 1, in thousands of bushels.			Per cent of crop shipped out of county where grown.			Price per bushel to producers Mar. 1.		
	1915	1914	10-year average.	1915	1914	5-year average.	1915	1914	10-year average.	1915	1914	5-year average.
	P.ct.	*P.ct.*	*P.ct.*	*Bu.*	*Bu.*	*Bu.*	*P.ct.*	*P.ct.*	*P.ct.*	*Cts.*	*Cts.*	*Cts.*
Maine	34	36	34	1,966	2,016	1,681	1	2	2	66	60	56
New Hampshire	24	28	31	109	112	138	1	3	1	69	57	54
Vermont	35	38	38	1,175	1,178	1,061	1	1	1	65	50	53
Massachusetts	25	24	32	83	72	89	1	1	1	62	52	54
Rhode Island	26	27	31	14	14	17	1	0	0	60	0	59
Connecticut	20	27	26	64	81	90	0	0	0	64	50	52
New York	38	43	43	15,262	18,361	16,525	5	7	7	62	47	47
New Jersey	35	35	40	680	700	735	8	13	13	60	47	48
Pennsylvania	39	42	40	12,554	15,036	13,783	8	5	7	59	47	48
Delaware	20	25	27	22	25	26	10	10	10	55	45	44
Maryland	25	26	28	290	338	334	12	15	12	61	50	48
Virginia	23	30	31	681	1,260	1,112	5	7	7	68	56	57
West Virginia	24	28	32	504	784	712	3	2	3	61	55	55
North Carolina	18	20	22	788	900	733	2	2	2	71	60	63
South Carolina	15	18	17	1,125	1,530	1,297	3	4	4	71	68	67
Georgia	19	19	16	1,710	1,748	1,297	4	6	4	73	67	68
Florida	15	15	16	135	135	118	1	2	3	71	65	71
Ohio	31	36	36	15,601	19,584	23,978	35	31	32	52	39	40
Indiana	24	29	31	10,773	10,556	17,358	42	43	44	52	37	38
Illinois	29	37	35	36,537	38,517	51,877	47	45	50	52	37	38
Michigan	40	39	38	20,301	17,550	18,045	23	23	26	51	39	40
Wisconsin	36	45	44	22,356	37,350	32,907	20	17	18	53	36	39
Minnesota	37	44	41	31,494	49,544	39,829	30	28	29	48	32	35
Iowa	37	40	40	61,050	67,360	68,451	49	44	41	50	34	35
Missouri	26	28	34	6,708	7,420	10,297	10	10	15	57	44	43
North Dakota	43	47	48	27,909	27,166	27,646	18	14	16	45	31	35
South Dakota	42	43	42	18,549	18,103	15,598	30	25	27	46	32	34
Nebraska	42	38	41	29,232	22,048	22,356	29	17	32	47	37	37
Kansas	33	23	33	19,457	7,889	13,838	15	2	13	51	46	43
Kentucky	23	23	30	845	736	912	4	2	6	65	53	53
Tennessee	24	26	27	1,932	1,638	1,526	16	15	17	59	59	56
Alabama	15	14	15	1,287	938	686	3	2	2	74	67	67
Mississippi	15	16	18	552	448	342	6	2	1	67	60	63
Louisiana	10	15	15	161	150	121	5	3	1	66	62	60
Texas	21	22	18	4,725	7,150	4,397	28	32	25	60	50	55
Oklahoma	23	25	27	6,958	4,625	4,967	24	18	22	52	49	49
Arkansas	25	27	26	1,560	1,728	1,195	5	5	3	64	52	57
Montana	29	46	38	5,380	10,028	7,981	31	28	34	48	35	41
Wyoming	30	35	33	2,362	2,940	2,354	14	25	15	55	40	49
Colorado	33	35	34	4,290	3,745	3,325	27	30	27	48	48	47
New Mexico	25	20	22	494	300	309	25	15	11	60	34	53
Arizona	20	23	19	67	69	40	10	10	12	.....	78	71
Utah	37	32	33	1,758	1,312	1,299	25	31	27	50	40	48
Nevada	23	31	24	155	155	109	17	16	16	65	55	59
Idaho	21	32	30	3,068	4,832	4,493	42	41	44	47	33	39
Washington	20	33	27	2,792	4,686	3,734	41	45	42	53	40	44
Oregon	23	33	29	2,930	5,016	3,756	34	32	34	50	39	46
California	12	15	13	924	990	873	35	50	42	51	45	53
United States..	33.2	37.4	37.4	379,369	419,463	424,347	29.4	26.5	29.4	52.1	38.9	40.1

TABLE 9.—*Barley: Estimated stocks on farms, price per bushel Mar. 1, 1915, and percentage of crop which moved out of county where grown, by States, with comparisons.*

State.	Per cent of crop on farms Mar. 1.			Quantity on farms, Mar. 1, in thousands of bushels.			Per cent of crop shipped out of county where grown.			Price per bushel to producers, Mar. 1.		
	1915	1914	1913	1915	1914	5-year average.	1915	1914	1913	1915	1914	5-year average.
	P. c.	*P. c.*	*P. c.*	*Bu.*	*Bu.*	*Bu.*	*P. c.*	*P. c.*	*P. c.*	*Cts.*	*Cts.*	*Cts.*
Maine	24	20	23	36	28	28	1	1	1	.....	76	80
New Hampshire	7	20	25	2	6	4	0	0	0	90	80	81
Vermont	25	25	25	104	96	96	0	1	0	97	75	80
New York	26	23	33	546	473	528	14	16	20	83	71	77
Pennsylvania	23	27	28	45	49	56	5	7	10	80	75	72
Maryland	15	14	10	25	20	17	5	5	5	81	62	62
Virginia	10	17	18	29	49	44	7	6	7	.....	70	66
Ohio	26	27	32	228	259	160	40	28	38	62	56	66
Indiana	23	22	30	46	44	53	20	45	40	65	50	60
Illinois	27	28	38	438	393	469	45	40	41	71	56	64
Michigan	26	25	27	608	527	488	19	21	25	75	65	68
Wisconsin	24	33	33	4,423	5,981	5,576	40	42	41	73	53	70
Minnesota	26	31	34	8,240	10,788	8,939	56	53	60	63	47	63
Iowa	22	23	29	2,059	2,300	3,069	62	60	60	68	52	64
Missouri	20	20	35	24	22	35	10	0	19	.....	.....	70
North Dakota	25	27	31	7,060	6,885	6,179	45	50	65	60	40	55
South Dakota	26	23	25	5,083	3,856	3,861	55	61	64	62	45	60
Nebraska	30	21	31	797	370	494	30	21	16	54	48	53
Kansas	33	25	44	1,940	486	940	30	20	20	59	54	59
Kentucky	10	7	9	14	6	9	4	5	20	84	70	73
Tennessee	15	6	5	20	3	9	15	10	0	95	90	83
Texas	30	15	26	60	25	19	10	10	15	71	73	87
Oklahoma	11	12	15	19	8	26	9	5	16	80	77	62
Montana	22	30	44	470	558	394	21	40	38	65	55	63
Wyoming	30	25	45	158	99	100	4	5	25	69	64	71
Colorado	26	25	35	1,031	812	650	22	20	25	69	56	60
New Mexico	30	20	12	51	19	12	5	10	10	78	75	73
Arizona	10	19	24	126	282	212	35	40	20	65	60	71
Utah	26	25	29	374	289	238	35	35	30	57	55	64
Nevada	20	25	30	122	123	128	20	10	20	97	80	81
Idaho	19	23	25	1,336	1,739	1,327	44	45	31	60	50	54
Washington	19	23	20	1,349	1,677	1,313	50	68	50	76	51	60
Oregon	15	21	24	549	882	819	25	31	40	76	57	63
California	13	15	16	5,468	4,972	5,162	45	50	60	76	60	68
United States	22.0	24.8	27.8	42,889	44,126	41,454	45.1	48.4	53.7	67.7	51.1	62.9

AGGREGATE VALUE PER ACRE OF CROPS, BY STATES, 1909-1914.

TABLE 10.—*Aggregate value per acre of crop production.*

[The tabulation below gives the average value per acre of 12 leading crops (corn, wheat, oats, barley, rye, buckwheat, potatoes, hay, flaxseed, cotton, rice, and tobacco) which represent more than 90 per cent of the total area of all crops, and which closely approximate the value per acre of all crops. For comparison the value of all crops which had acreage reports in the census of 1909 is also given.]

State and division.	Value per acre.						
	12 crops combined.						Census, all crops with acreage reports, 1909
	1914	1913	1912	1911	1910	Census, 1909	
Maine	$22.15	$23.72	$23.43	$26.24	$23.35	$20.91	$19.80
New Hampshire	22.58	20.44	21.51	21.77	21.41	19.53	19.29
Vermont	20.20	20.78	22.61	20.47	18.39	17.61	18.17
Massachusetts	36.20	32.34	34.38	31.59	29.94	30.89	41.38
Rhode Island	32.07	32.25	30.62	32.81	29.04	29.01	40.50
Connecticut	41.50	37.63	43.04	40.69	37.77	35.16	35.84
New York	21.06	19.33	20.04	20.80	19.51	18.39	20.80
New Jersey	28.76	29.02	28.70	26.67	26.59	26.31	33.19
Pennsylvania	22.13	21.34	22.41	21.11	20.60	18.16	18.90
Delaware	22.43	18.47	19.00	19.82	18.17	17.00	19.36
Maryland	23.25	18.85	19.55	18.97	19.52	18.66	20.54
Virginia	18.12	23.69	19.58	18.31	19.18	17.63	20.31
West Virginia	20.61	21.67	21.57	16.79	18.51	16.71	17.67
North Carolina	20.18	24.84	22.35	20.82	21.46	18.02	22.28
South Carolina	17.88	25.18	21.35	22.55	24.59	22.48	26.45
Georgia	14.69	20.80	16.42	19.52	19.47	19.32	22.20
Florida	17.39	17.85	14.41	15.70	15.58	15.00	21.54
Ohio	19.79	19.29	17.75	19.45	16.89	19.07	18.83
Indiana	17.27	17.28	14.97	16.69	14.88	17.29	17.07
Illinois	16.25	14.87	15.37	15.99	14.30	17.56	17.88
Michigan	18.96	16.83	16.42	19.89	16.39	16.85	17.32
Wisconsin	18.55	19.41	17.63	20.64	15.10	16.54	15.77
Minnesota	13.19	12.26	11.80	13.16	12.96	13.72	12.61
Iowa	17.92	17.01	14.30	14.13	12.22	14.40	14.94
Missouri	13.96	12.29	13.98	13.24	13.84	14.16	14.25
North Dakota	11.10	8.15	11.49	9.13	4.55	12.36	11.35
South Dakota	10.79	9.48	10.21	6.29	10.12	12.05	10.17
Nebraska	14.19	10.85	9.80	10.59	9.95	12.36	11.19
Kansas	15.66	7.00	10.60	8.94	9.95	11.25	10.68
Kentucky	20.22	19.12	20.14	18.81	20.25	20.68	20.82
Tennessee	16.75	18.01	17.36	17.40	17.61	15.81	17.06
Alabama	14.16	20.00	17.45	17.32	18.56	15.69	18.87
Mississippi	13.68	19.62	17.01	15.39	20.48	17.59	22.69
Louisiana	15.40	19.05	17.76	15.86	16.08	15.60	20.36
Texas	13.48	18.52	19.50	13.97	17.87	15.50	15.82
Oklahoma	12.21	10.06	11.34	7.93	14.02	11.80	10.95
Arkansas	14.01	18.56	17.93	16.68	19.40	16.61	20.24
Montana	18.23	16.07	16.24	20.41	18.78	20.45	15.40
Wyoming	18.54	15.37	17.74	21.11	25.88	16.52	12.45
Colorado	18.97	18.88	17.41	17.02	19.96	20.50	17.02
New Mexico	23.58	22.26	19.45	28.78	22.81	19.06	12.76
Arizona	29.34	38.85	38.52	30.02	29.67	29.77	25.97
Utah	22.72	21.66	22.14	22.37	24.58	23.25	23.15
Nevada	29.70	32.30	29.93	34.92	37.12	26.30	14.73
Idaho	20.90	19.93	19.04	23.47	21.86	22.15	19.52
Washington	23.96	20.00	18.78	21.42	19.65	21.11	20.63
Oregon	19.57	18.67	18.66	19.24	21.88	18.99	18.54
California	18.40	20.25	21.84	21.96	18.82	19.51	20.39
United States	16.34	16.31	15.96	15.51	15.52	16.02	16.20
Geographic division:							
North Atlantic	22.93	21.90	22.75	22.30	21.24	19.61	21.55
South Atlantic	17.92	22.54	19.31	19.20	20.47	19.19	22.23
North Central, East	17.79	17.07	16.22	17.66	15.30	17.57	17.53
North Central, West	14.28	11.52	11.91	11.98	10.67	12.96	12.24
South Central	14.40	17.45	17.31	14.52	17.79	15.75	17.06
Western	20.25	19.59	19.55	21.43	20.63	20.39	18.76

FARM WAGES.

TABLE 11.—*Wages of male farm labor.*

State and division.	Per month with board.				Per month without board.			
	1914	1913	1909	1899	1914	1913	1909	1899
Maine	$26.30	$25.50	$26.71	$18.00	$37.20	$36.00	$37.38	$26.58
New Hampshire	24.70	24.70	25.18	18.48	38.50	38.60	37.92	28.22
Vermont	26.30	26.30	25.93	18.74	37.50	37.00	36.51	27.49
Massachusetts	25.00	25.50	26.52	18.32	41.00	42.00	41.40	31.25
Rhode Island	24.50	25.00	24.62	18.35	38.40	39.40	43.11	30.56
Connecticut	22.90	23.90	24.61	17.52	37.80	39.30	36.92	30.28
New York	25.40	25.50	24.78	17.52	25.70	36.20	33.64	24.88
New Jersey	21.00	21.20	20.50	15.19	34.00	35.50	32.01	25.30
Pennsylvania	20.40	20.60	19.69	14.32	31.20	32.00	29.45	22.71
Delaware	17.80	17.20	17.12	11.98	26.50	26.00	26.14	18.55
Maryland	17.00	17.30	15.96	11.53	26.00	26.50	23.82	17.92
Virginia	16.20	16.10	15.00	10.43	22.80	23.50	21.11	14.82
West Virginia	21.00	21.20	20.33	13.55	30.00	30.50	28.05	19.85
North Carolina	15.50	15.90	14.05	8.56	21.90	22.30	19.55	12.39
South Carolina	12.00	13.40	11.96	7.34	16.50	17.90	15.71	10.06
Georgia	12.80	14.30	13.21	8.05	18.00	20.20	18.33	11.38
Florida	16.50	17.90	17.86	11.32	24.50	26.70	26.64	17.40
Ohio	22.50	22.70	21.35	15.27	31.80	32.20	28.84	22.14
Indiana	22.10	22.30	21.40	15.45	30.10	30.20	27.91	21.87
Illinois	24.80	25.30	24.52	17.76	33.00	33.30	31.31	24.34
Michigan	24.70	24.90	24.36	16.95	34.70	35.00	32.96	24.12
Wisconsin	28.00	28.10	27.52	19.20	39.90	39.80	36.92	27.68
Minnesota	28.70	28.90	28.30	19.98	40.80	41.00	38.90	29.46
Iowa	30.10	30.70	28.14	19.32	40.00	40.20	36.19	27.09
Missouri	21.10	21.60	20.56	14.57	29.20	29.40	27.74	20.44
North Dakota	31.20	31.00	32.33	21.82	45.10	42.50	45.96	32.84
South Dakota	30.10	30.00	30.38	20.41	43.50	43.00	40.75	30.58
Nebraska	28.10	26.90	27.50	18.87	39.70	38.40	37.98	27.40
Kansas	24.80	24.00	25.21	17.40	35.10	33.70	34.79	25.24
Kentucky	17.20	17.40	17.13	12.24	24.20	24.00	22.38	16.64
Tennessee	15.20	15.80	14.98	10.33	21.10	22.30	20.36	14.21
Alabama	13.00	14.40	13.19	8.63	18.90	20.30	18.63	12.56
Mississippi	12.70	13.60	14.21	9.27	18.20	19.60	19.79	13.17
Louisiana	14.30	14.00	13.94	10.30	20.70	20.70	19.54	14.88
Texas	19.10	19.20	18.47	12.94	27.00	27.50	25.14	17.98
Oklahoma	20.20	20.00	20.87	14.52	28.80	29.10	28.70	21.55
Arkansas	16.40	17.00	16.31	10.54	24.00	24.50	22.68	15.09
Montana	36.10	37.20	38.05	32.12	52.80	54.00	53.32	42.78
Wyoming	34.20	34.70	34.53	29.64	50.00	49.20	43.98	42.54
Colorado	30.00	29.10	31.53	23.23	44.60	44.30	45.59	34.36
New Mexico	25.00	24.80	25.62	18.45	36.60	36.00	34.17	25.22
Arizona	34.00	35.00	35.28	28.23	48.00	48.50	48.24	38.26
Utah	36.00	38.50	40.77	25.72	50.00	51.00	56.12	34.43
Nevada	39.00	39.70	40.30	31.76	56.00	56.50	54.95	45.10
Idaho	35.70	36.00	39.38	28.13	51.00	50.00	51.64	39.39
Washington	32.90	33.20	35.43	25.06	48.40	48.40	48.54	36.77
Oregon	32.00	31.00	33.11	22.89	46.00	44.50	43.98	31.23
California	34.80	35.10	34.17	25.64	50.10	50.70	47.30	36.87
United States	21.05	21.38	20.01	13.90	29.88	30.31	27.43	19.97
Geographic division:								
North Atlantic	23.31	23.45	23.26	16.60	34.71	35.29	33.68	25.44
South Atlantic	15.14	15.88	14.42	9.26	21.50	22.62	20.13	13.35
North Central	25.44	25.56	24.66	17.36	35.35	35.23	32.90	24.75
South Central	16.27	16.70	15.91	10.97	23.19	23.85	21.85	15.47
Western	33.30	33.52	34.44	25.19	48.17	48.17	47.24	35.64

TABLE 11.—*Wages of male farm labor*—Concluded.

State and division.	Per day at harvest with board.			Per day at harvest without board.			Per day other than harvest with board.			Per day other than harvest without board.		
	1914	1913	1909	1914	1913	1909	1914	1913	1909	1914	1913	1909
Maine	$1.73	$1.71	$1.63	$2.14	$2.12	$2.02	$1.37	$1.35	$1.28	$1.77	$1.74	$1.59
New Hampshire	1.68	1.70	1.71	2.12	2.15	2.12	1.35	1.39	1.31	1.78	1.79	1.70
Vermont	1.70	1.71	1.73	2.15	2.06	2.14	1.28	1.31	1.21	1.67	1.65	1.54
Massachusetts	1.60	1.61	1.60	2.11	2.06	2.03	1.35	1.39	1.04	1.87	1.87	1.69
Rhode Island	1.56	1.53	1.50	2.00	2.00	1.94	1.30	1.25	1.12	1.70	1.72	1.60
Connecticut	1.53	1.55	1.44	1.94	1.95	1.85	1.27	1.25	1.14	1.74	1.75	1.54
New York	1.85	1.80	1.77	2.26	2.30	2.07	1.37	1.41	1.26	1.76	1.82	1.59
New Jersey	1.73	1.78	1.71	2.17	2.25	2.08	1.24	1.23	1.09	1.65	1.67	1.47
Pennsylvania	1.51	1.53	1.42	1.91	1.94	1.82	1.17	1.17	1.04	1.52	1.58	1.41
Delaware	1.45	1.40	1.38	1.74	1.74	1.61	1.03	.94	.95	1.30	1.19	1.14
Maryland	1.38	1.30	1.31	1.72	1.65	1.54	.94	.91	.90	1.26	1.22	1.17
Virginia	1.21	1.25	1.12	1.49	1.52	1.37	.85	.86	.74	1.09	1.11	.96
West Virginia	1.40	1.31	1.21	1.75	1.73	1.53	1.03	1.04	.89	1.40	1.36	1.18
North Carolina	1.14	1.13	1.01	1.38	1.40	1.20	.81	.83	.70	1.02	1.06	.89
South Carolina	.96	1.03	.94	1.17	1.29	1.06	.64	.73	.60	.82	.91	.71
Georgia	.97	1.10	.90	1.20	1.38	1.12	.74	.82	.71	.94	1.04	.91
Florida	1.07	1.12	1.06	1.34	1.40	1.46	.95	.98	.86	1.24	1.30	1.21
Ohio	1.79	1.81	1.67	2.21	2.23	2.02	1.31	1.33	1.18	1.70	1.71	1.47
Indiana	1.76	1.80	1.66	2.16	2.20	1.97	1.23	1.25	1.13	1.56	1.59	1.38
Illinois	1.88	1.93	1.84	2.25	2.33	2.11	1.31	1.39	1.33	1.69	1.73	1.56
Michigan	1.86	1.94	1.75	2.24	2.37	2.13	1.38	1.41	1.26	1.75	1.82	1.62
Wisconsin	1.87	1.90	1.79	2.33	2.36	2.19	1.45	1.46	1.35	1.87	1.93	1.70
Minnesota	2.36	2.43	2.23	2.80	2.83	2.59	1.66	1.67	1.53	2.05	2.14	1.88
Iowa	2.24	2.25	2.08	2.60	2.62	2.43	1.67	1.70	1.53	2.10	2.13	1.82
Missouri	1.55	1.57	1.50	1.93	1.95	1.81	1.05	1.08	1.00	1.35	1.39	1.27
North Dakota	2.68	2.70	2.58	3.25	3.35	3.17	1.75	1.85	1.66	2.33	2.50	2.14
South Dakota	2.40	2.37	2.38	2.92	2.96	2.82	1.71	1.69	1.69	1.20	2.22	2.19
Nebraska	2.21	2.19	2.22	2.64	2.68	2.59	1.57	1.57	1.58	1.99	2.06	1.94
Kansas	2.30	2.14	2.17	2.71	2.48	2.43	1.40	1.35	1.44	1.77	1.75	1.73
Kentucky	1.38	1.36	1.31	1.68	1.68	1.56	.86	.87	.82	1.11	1.13	1.00
Tennessee	1.15	1.18	1.11	1.42	1.47	1.34	.79	.81	.74	1.00	1.03	.92
Alabama	.95	1.00	.89	1.18	1.26	1.12	.73	.83	.68	.95	1.04	.87
Mississippi	.82	.93	.89	1.06	1.16	1.13	.72	.85	.75	.98	1.08	.96
Louisiana	1.00	1.00	.92	1.25	1.28	1.16	.86	.85	.79	1.04	1.10	1.00
Texas	1.32	1.30	1.20	1.67	1.63	1.44	1.03	1.08	.93	1.34	1.34	1.16
Oklahoma	1.72	1.60	1.61	2.05	2.00	1.81	1.13	1.10	1.12	1.45	1.47	1.37
Arkansas	1.16	1.24	1.11	1.46	1.53	1.37	.88	.92	.83	1.12	1.18	1.05
Montana	2.26	2.21	2.23	2.94	2.90	2.58	1.80	1.76	1.68	2.54	2.52	2.31
Wyoming	1.98	1.94	1.99	2.57	2.54	2.33	1.64	1.59	1.54	2.22	2.22	2.04
Colorado	1.84	1.75	1.80	2.32	2.27	2.26	1.42	1.36	1.44	1.98	1.95	1.87
New Mexico	1.42	1.37	1.28	1.80	1.74	1.62	1.16	1.13	1.06	1.53	1.53	1.39
Arizona	1.80	1.88	1.73	2.32	2.31	2.13	1.50	1.46	1.35	1.95	2.00	1.74
Utah	1.96	1.96	2.00	2.35	2.37	2.38	1.70	1.75	1.61	2.12	2.15	2.07
Nevada	2.00	2.05	2.04	2.60	2.75	2.40	1.61	1.65	1.42	2.50	2.38	.....
Idaho	2.28	2.31	2.17	2.73	2.76	2.72	1.71	1.72	1.70	2.28	2.32	2.22
Washington	2.29	2.41	2.34	2.75	2.90	2.58	1.60	1.67	1.66	2.18	2.20	2.25
Oregon	2.12	2.09	2.06	2.55	2.60	2.29	1.48	1.48	1.42	2.01	1.98	1.79
California	1.96	1.97	2.01	2.47	2.48	2.31	1.44	1.44	1.43	2.05	2.01	1.94
United States	1.55	1.57	1.43	1.91	1.94	1.71	1.13	1.16	1.03	1.45	1.50	1.29
Geographic division:												
North Atlantic	1.68	1.67	1.62	2.09	2.12	1.98	1.28	1.30	1.16	1.67	1.71	1.53
South Atlantic	1.12	1.16	1.03	1.38	1.45	1.25	.81	.85	.73	1.05	1.09	.93
North Central	1.98	2.00	1.87	2.39	2.42	2.21	1.40	1.42	1.32	1.75	1.83	1.62
South Central	1.20	1.21	1.10	1.49	1.51	1.34	.88	.93	.82	1.14	1.18	1.02
Western	2.02	2.02	2.02	2.51	2.53	2.51	1.52	1.52	1.48	2.09	2.07	1.97

PRICES OF FARM PRODUCTS.

TABLE 12.—*Prices paid to producers of farm products, by States.*

MARCH 1.

State.	Rye, per bushel.		Buckwheat, per bushel.		Potatoes, per bushel.		Hay, per ton.		Flaxseed, per bushel.		Cotton, per pound.		Butter, per pound.		Eggs, per dozen.		Chickens, per pound.	
	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Dols.*	*Dols.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Maine	.....	.....	.....	72	28	55	14.00	14.68	.....	.....	.....	.....	30	31	27	27	14.6	14.3
New Hampshire	90	.....	.....	70	51	75	15.80	16.70	.....	.....	.....	.....	32	32	28	29	13.8	14.4
Vermont	80	.....	89	89	48	69	15.10	13.90	.....	.....	.....	.....	34	32	28	27	13.7	13.0
Massachusetts	109	97	110	88	60	85	23.00	20.62	.....	.....	.....	.....	36	35	32	33	17.5	15.8
Rhode Island	110	.....	.....	.....	50	88	22.40	21.46	.....	.....	.....	.....	36	35	30	33	20.0	16.1
Connecticut	100	88	100	90	56	91	20.50	21.66	.....	.....	.....	.....	36	35	31	32	17.8	15.9
New York	110	78	94	71	43	68	15.50	15.58	.....	.....	.....	.....	33	31	28	28	15.9	14.2
New Jersey	108	77	85	74	60	82	19.70	19.22	.....	.....	.....	.....	35	34	30	30	16.9	16.3
Pennsylvania	105	78	79	67	58	74	14.70	16.42	.....	.....	.....	.....	32	31	26	26	14.2	13.0
Delaware	110	73	.....	.....	73	88	20.30	17.48	.....	.....	.....	.....	32	30	26	24	14.5	13.4
Maryland	109	74	82	74	54	72	16.50	16.74	.....	.....	.....	.....	29	28	22	22	13.8	14.2
Virginia	95	82	96	78	75	83	18.80	16.48	.....	.....	8.0	13.4	27	26	20	21	13.4	13.2
West Virginia	105	85	80	76	82	87	17.80	16.36	.....	.....	.....	.....	26	26	23	23	12.8	12.0
North Carolina	105	99	87	82	96	91	18.30	16.42	.....	.....	7.4	12.5	24	24	17	19	11.6	10.8
South Carolina	147	153	.....	.....	115	131	17.00	17.96	.....	.....	7.6	12.5	26	25	19	21	12.7	11.3
Georgia	116	140	.....	.....	113	114	16.20	17.72	.....	.....	7.3	12.5	23	25	17	20	13.2	12.4
Florida	.....	.....	.....	.....	120	138	17.00	17.38	.....	.....	10.9	16.8	35	32	22	24	16.3	13.7
Ohio	106	73	74	76	52	71	14.20	14.06	.....	.....	.....	.....	26	26	20	22	11.7	11.7
Indiana	102	70	86	70	55	71	14.60	13.42	.....	.....	.....	.....	24	24	19	20	11.4	11.1
Illinois	98	69	.....	97	67	77	14.90	13.84	.....	.....	.....	.....	26	25	21	21	11.4	10.9
Michigan	109	70	77	67	28	48	12.30	13.74	.....	.....	.....	.....	28	26	25	24	11.5	11.3
Wisconsin	111	68	78	70	31	48	9.80	12.94	130	182	.....	.....	30	28	24	23	11.5	11.0
Minnesota	108	63	75	66	37	52	6.80	7.90	163	175	.....	.....	28	27	23	22	10.2	9.5
Iowa	94	68	90	91	69	74	12.10	10.64	139	162	.....	.....	28	26	22	19	10.6	9.9
Missouri	103	76	116	98	80	88	14.40	11.50	150	129	7.1	11.8	23	22	18	19	10.8	10.4
North Dakota	105	59	.....	.....	50	62	5.70	6.78	163	177	.....	.....	25	24	25	24	10.0	9.6
South Dakota	100	59	.....	.....	57	72	6.40	7.16	153	172	.....	.....	26	24	23	20	9.0	8.9
Nebraska	98	61	85	107	71	81	7.50	8.58	122	158	.....	.....	23	23	20	19	9.6	9.1
Kansas	93	72	.....	.....	83	97	8.40	9.54	138	159	.....	.....	24	23	18	18	9.8	9.5
Kentucky	109	89	.....	.....	81	88	17.80	15.36	.....	.....	.....	.....	22	21	17	18	10.8	10.7
Tennessee	106	95	80	75	99	97	17.60	15.64	.....	.....	6.8	12.3	20	20	17	18	10.8	10.6
Alabama	150	145	.....	.....	110	118	14.10	14.72	.....	.....	7.3	12.5	22	21	16	18	12.0	11.2
Mississippi	130	.....	.....	.....	116	119	11.90	12.76	.....	.....	7.3	12.4	22	23	16	19	11.1	11.7
Louisiana	.....	.....	.....	.....	115	107	11.90	12.94	.....	.....	7.4	12.1	29	28	20	19	14.0	13.2
Texas	117	106	.....	.....	123	122	9.80	12.12	.....	.....	7.5	12.1	22	22	16	17	9.6	8.9
Oklahoma	115	79	.....	.....	99	115	8.90	9.34	.....	.....	7.6	11.6	22	22	18	18	9.6	9.1
Arkansas	103	93	.....	.....	112	113	13.60	13.04	.....	.....	7.5	11.9	23	23	18	18	10.5	9.9
Montana	79	73	.....	.....	68	70	8.10	11.04	148	138	.....	.....	34	35	29	33	14.1	14.2
Wyoming	76	65	.....	.....	84	89	7.00	9.98	.....	.....	.....	.....	32	32	28	29	14.8	13.4
Colorado	85	64	.....	.....	60	65	7.60	10.20	135	.....	.....	.....	28	29	24	25	12.0	13.2
New Mexico	.....	.....	.....	.....	118	104	12.00	12.52	.....	.....	.....	.....	36	33	31	27	14.0	13.9
Arizona	.....	.....	.....	.....	141	124	10.00	12.98	.....	.....	.....	.....	37	38	27	32	17.4	18.2
Utah	80	70			55	63	7.40	9.08	.....	.....	.....	.....	27	29	22	23	10.8	11.8
Nevada	.....	.....	.....	.....	97	83	7.50	10.68	.....	.....	.....	.....	36	36	34	37	20.3	19.6
Idaho	80	70	.....	.....	46	61	8.00	9.04	.....	.....	.....	.....	26	32	25	29	9.7	11.6
Washington	84	76	.....	.....	60	60	11.70	12.46	.....	.....	.....	.....	31	33	24	27	13.3	13.6
Oregon	117	92	.....	.....	70	61	9.90	10.70	.....	.....	.....	.....	31	33	26	26	12.7	12.8
California	100	85	.....	.....	70	88	8.00	12.34	.....	.....	8.6	.....	30	32	24	23	16.0	14.5
United States	105.4	71.5	85.5	70.7	50.4	66.9	11.71	12.84	157.9	173.8	7.4	12.4	26.8	25.9	21.3	21.5	11.7	11.2

TABLE 12.—*Prices paid to producers of farm products, by States*—Continued.

FEBRUARY 15.

State.	Hogs, per 100 pounds.		Beef cattle, per 100 pounds.		Veal calves, per 100 pounds.		Sheep, per 100 pounds.		Lambs, per 100 pounds.		Milch cows, per head.		Horses, per head.		Wool, per pound.	
	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	1914
															Cts.	*Cts.*
Maine	$7.30	$7.46	$6.90	$6.42	$8.50	$7.94	$5.10	$3.98	$6.10	$6.30	$57.90	$51.16	$210	$185	23	20
New Hampshire	7.30	7.80	7.00	6.15	8.50	7.40	5.00	4.75	6.00	6.45	59.00	53.75	186	162	21	16
Vermont	6.30	7.14	4.90	5.08	7.60	6.78	3.70	3.80	5.70	5.90	55.00	45.42	175	158	24	17
Massachusetts	7.10	8.28	6.20	5.67	8.90	8.38	.....	.....	.....	.....	66.30	55.95	175	188	25	23
Rhode Island	8.20	8.23	7.40	6.73	9.70	9.03	5.50	5.23	7.70	7.73	78.80	66.83	225	203	22	16
Connecticut	9.00	9.13	8.00	7.00	10.50	8.90	8.30	5.67	11.50	7.67	74.40	56.50	205	217	24	20
New York	7.30	7.50	6.20	5.30	9.80	8.38	4.50	4.22	7.10	6.40	67.20	54.34	179	175	23	18
New Jersey	8.50	9.18	6.50	7.46	10.00	8.56	4.70	5.23	8.50	7.47	73.00	59.02	178	185	....	20
Pennsylvania	7.50	7.96	6.90	5.92	9.20	8.04	5.00	4.64	7.10	6.32	60.30	50.44	171	168	22	20
Delaware	7.50	7.90	6.30	5.63	9.70	9.18	4.70	4.93	6.70	7.33	55.00	47.67	129	133	25	22
Maryland	7.30	7.60	.....	5.80	.....	8.40	.....	4.56	.....	6.50	.....	45.62	.....	141	.....	.....
Virginia	7.10	7.26	6.20	5.04	8.30	7.10	4.50	4.20	6.90	6.04	47.70	38.76	137	142	23	19
West Virginia	7.30	7.38	6.30	5.30	7.90	6.88	4.60	4.30	6.50	5.76	53.40	42.04	145	141	24	20
North Carolina	7.60	7.44	4.80	4.26	6.00	5.30	4.60	4.36	5.50	5.18	38.50	33.52	148	155	20	18
South Carolina	7.70	7.50	4.40	3.80	5.30	4.48	4.90	4.38	5.80	5.42	38.40	33.88	145	170	17	18
Georgia	7.20	7.26	4.30	3.76	4.70	4.48	4.20	4.14	5.80	5.50	37.10	32.82	142	158	20	21
Florida	6.50	7.12	5.40	4.94	5.00	5.95	4.10	5.83	5.80	.....	46.00	41.06	145	152	20	18
Ohio	6.40	7.54	6.60	5.80	8.40	7.94	4.80	4.30	6.90	6.28	59.40	51.72	158	165	24	19
Indiana	6.30	7.44	6.40	5.48	7.80	7.26	4.30	4.00	6.70	5.98	54.00	50.70	139	152	22	19
Illinois	6.20	7.32	6.40	5.68	8.00	7.18	4.90	4.40	6.60	6.00	63.80	54.02	141	155	21	17
Michigan	6.20	7.24	6.00	5.02	8.10	7.50	4.40	4.28	6.80	6.32	60.00	48.24	166	172	23	19
Wisconsin	6.40	7.20	5.30	4.82	8.00	7.10	4.90	4.20	6.50	5.86	63.00	52.08	167	171	21	18
Minnesota	6.10	7.10	5.30	4.66	7.20	6.38	4.60	4.26	6.20	5.68	58.60	45.54	148	162	18	16
Iowa	6.20	7.24	6.50	5.90	7.70	6.64	5.10	4.54	6.90	6.02	58.50	52.02	142	163	19	17
Missouri	6.00	6.94	6.30	5.44	7.10	6.30	4.70	4.20	6.30	5.46	55.40	46.42	110	125	20	17
North Dakota	5.70	6.68	5.30	4.46	7.10	6.10	4.70	4.42	6.10	5.54	61.80	48.28	135	150	17	13
South Dakota	6.00	6.88	5.90	5.16	7.20	6.04	5.20	4.48	6.50	5.68	61.30	48.70	120	141	18	15
Nebraska	6.00	6.98	6.30	5.60	7.70	6.82	5.60	4.92	7.30	6.38	65.90	52.06	122	133	21	15
Kansas	6.10	7.08	6.50	5.74	7.80	6.70	5.50	4.90	6.70	6.18	67.40	50.66	120	130	19	15
Kentucky	6.30	7.04	5.90	4.92	7.40	6.30	3.90	3.64	6.00	5.38	48.30	40.40	114	129	22	19
Tennessee	6.30	6.80	5.40	4.34	6.70	5.54	3.90	3.66	5.60	5.06	43.30	37.76	124	145	19	17
Alabama	6.40	6.92	4.10	3.32	5.20	4.66	4.90	3.92	5.40	4.94	36.70	31.74	120	138	18	17
Mississippi	5.60	6.30	4.20	3.48	5.00	4.68	4.00	3.48	5.20	4.62	36.80	30.74	104	115	16	15
Louisiana	6.00	5.86	5.20	3.96	5.90	4.66	6.00	4.32	7.00	4.55	38.00	29.96	100	86	14	14
Texas	6.40	6.70	5.40	4.28	6.20	5.16	5.00	4.30	5.80	5.36	54.40	43.78	88	97	16	13
Oklahoma	6.00	6.88	5.50	4.80	6.70	5.76	5.20	4.86	6.40	6.08	57.70	45.34	101	109	16	....
Arkansas	5.50	5.98	4.60	3.84	5.70	5.04	3.80	3.66	4.50	4.46	40.90	32.14	93	108	17	15
Montana	6.00	7.36	6.20	5.74	7.80	8.00	5.50	4.82	7.00	6.28	76.00	58.56	137	134	22	....
Wyoming	6.50	7.68	6.90	5.60	10.00	7.34	6.00	4.76	7.90	6.30	83.50	60.16	110	107	22	14
Colorado	6.40	7.16	6.70	5.78	8.70	7.56	5.30	4.94	7.20	6.34	76.00	53.18	120	116	18	....
New Mexico	6.80	7.42	6.50	4.92	9.30	6.68	5.50	4.68	6.60	5.70	66.00	53.25	78	86	16	13
Arizona	7.20	7.70	6.40	5.42	8.50	6.33	5.10	3.83	.....	5.29	85.00	69.45	115	108	.....	.....
Utah	6.50	6.62	5.80	5.06	8.50	8.32	5.60	5.12	6.90	6.00	65.00	48.44	117	117	19	14
Nevada	7.60	8.00	6.30	5.75	7.80	7.33	5.30	5.03	6.40	6.50	85.00	62.67	127	124	....	13
Idaho	6.10	6.90	6.00	5.34	7.30	7.04	5.00	4.72	6.10	5.62	76.00	56.70	120	141	21	....
Washington	6.40	7.60	6.00	5.50	8.10	7.70	5.40	5.04	6.60	5.80	71.70	62.72	120	141	16	15
Oregon	6.30	7.54	6.40	5.82	7.80	7.36	5.40	4.82	6.00	5.92	69.00	55.34	101	124	19	14
California	6.90	7.32	6.40	5.98	7.70	6.56	5.70	4.76	6.50	5.74	66.20	55.14	111	139	16	12
United States	6.34	7.12	5.93	5.11	7.62	6.77	5.14	4.55	6.67	5.95	57.99	47.75	131.62	142.66	20.2	15.7

TABLE 12.—*Prices paid to producers of farm products, by States*—Continued.

FEBRUARY 15.

State.	Timothy hay, per ton.		Clover hay, per ton.		Alfalfa hay, per ton.	Prairie hay, per ton.	Soy beans, per bushel.		Cotton seed, per ton.		Apples, per bushel.		Walnuts, black, per bushel.	Hickory nuts, per bushel.	Peanuts, per pound.		Honey, comb, per pound.		Honey, extract, per pound.	
	1915		1915		1915	1915	1915	1914	1915	1914	1915	1914	1915	1915	1915	1914	1915	1914	1915	1914
	Dols.		*Dols.*		*Dols.*	*Dols.*	*Dls.*	*Dls.*	*Dols.*	*Dols.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Maine	14.70		13.50		.....	.....	.....	.....	.....	.....	60	130	200	.....	.....	.....	20	20	....	18
New Hampshire	16.30		14.30		.....	.....	.....	.....	.....	.....	64	135	....	.....	.....	.....	20	20	22	21
Vermont	14.10		13.70		.....	.....	.....	.....	.....	.....	80	125	....	.....	.....	.....	19	19	....	18
Massachusetts	21.10		18.00		.....	.....	.....	.....	.....	.....	85	140	....	.....	.....	.....	19	20	....	17
Rhode Island	21.50		.....		.....	.....	.....	.....	.....	.....	91	135	....	.....	.....	.....	24	21	15	15
Connecticut	21.80		18.20		.....	.....	.....	.....	.....	.....	75	125	....	275	.....	.....	19	20	16	....
New York	16.00		13.20		14.70	.....	.....	.....	.....	.....	51	110	56	228	.....	.....	15	15	13	12
New Jersey	19.50		17.20		22.70	.....	.....	.....	.....	.....	60	120	95	267	.....	.....	16	17	16	16
Pennsylvania	15.00		13.00		.....	.....	3.40	2.00	.....	.....	56	103	106	191	.....	.....	15	15	10	9
Delaware	16.60		14.70		.....	.....	3.50	.....	.....	.....	75	150	68	60	.....	.....	15	12	....	12
Maryland	17.00		14.50		.....	.....	.....	.....	.....	.....	50	135	.....	.....	.....	.....	.....	.....	.....	.....
Virginia	20.30		18.10		19.50	.....	2.98	2.14	32.00	29.80	61	120	56	108	3.7	4.5	13	13	13	14
West Virginia	19.30		16.90		23.00	.....	.....	2.88	.....	.....	56	155	60	146	.....	.....	18	18	15	14
North Carolina	21.00		19.10		21.70	.....	1.87	1.67	27.00	27.30	73	115	69	115	3.9	4.0	14	14	14	13
South Carolina	21.50		23.00		25.10	17.40	2.50	....	28.30	28.00	115	160	79	89	5.0	5.0	13	13	14	14
Georgia	24.70		21.60		24.80	16.40	2.70	3.03	28.30	27.90	100	140	70	81	5.2	5.5	12	12	12	13
Florida	28.50		.....		30.00	20.00	.....	.....	21.90	23.50	.....	.....	.....	.....	4.5	5.0	12	12	9	....
Ohio	14.50		13.20		16.40	.....	2.17	2.50	.....	.....	75	140	68	142	.....	.....	16	17	11	13
Indiana	15.70		13.70		16.20	7.60	2.41	2.20	.....	.....	98	115	67	138	.....	.....	17	17	15	17
Illinois	16.00		14.60		16.50	12.20	2.58	2.40	.....	.....	100	120	58	124	.....	.....	15	16	13	15
Michigan	11.90		10.40		14.20	6.30	2.45	2.00	.....	.....	68	100	60	132	.....	.....	14	15	10	11
Wisconsin	10.80		9.30		11.70	6.70	....	2.10	.....	.....	108	150	106	150	.....	.....	15	15	11	11
Minnesota	9.20		8.70		11.00	6.70	....	1.75	.....	.....	105	170	100	.....	.....	.....	15	15	14	14
Iowa	13.70		12.50		14.00	11.20	.....	.....	.....	.....	120	140	109	210	.....	.....	16	16	13	12
Missouri	15.10		14.50		15.30	11.70	2.58	2.88	26.30	24.00	102	125	60	105	....	5.5	16	16	13	13
North Dakota	7.30		8.20		11.00	6.50	.....	.....	.....	.....	145	.....	.....	.....	.....	.....	19	.....	.....	.....
South Dakota	10.00		9.60		9.90	7.00	.....	.....	.....	.....	150	190	.....	.....	.....	.....	16	17	14	15
Nebraska	10.00		9.50		9.00	8.00	....	1.80	.....	.....	120	164	94	150	.....	.....	15	16	11	13
Kansas	10.40		9.80		9.40	7.80	....	3.00	.....	.....	125	197	100	90	.....	.....	16	15	12	12
Kentucky	19.10		17.40		19.90	.....	2.01	2.46	.....	.....	95	135	53	102	....	6.2	14	15	14	17
Tennessee	20.30		18.80		19.80	13.00	1.95	2.18	22.40	25.10	105	145	64	96	4.0	3.4	14	13	14	13
Alabama	21.00		19.00		21.00	14.00	....	2.81	25.80	26.40	98	130	80	88	4.9	4.7	11	11	12	12
Mississippi	.....		14.20		17.60	10.00	1.96	2.08	23.30	24.10	100	100	82	96	4.0	4.6	11	12	12	13
Louisiana	.....		14.00		18.50	10.30	1.75	....	20.50	18.00	....	100	.....	.....	4.0	4.0	12	11	10	10
Texas	.....		.....		16.00	10.50	2.65	....	19.20	19.00	130	150	68	54	4.5	5.0	11	12	10	12
Oklahoma	.....		.....		12.10	8.90	1.75	2.10	19.40	20.00	125	150	110	125	5.5	5.5	16	15	12	12
Arkansas	19.00		18.00		18.20	11.90	2.50	2.10	20.30	19.20	105	140	63	78	4.2	5.0	12	13	12	14
Montana	10.20		9.00		8.90	8.30	.....	.....	.....	.....	75	135	.....	.....	.....	.....	13	14	11	....
Wyoming	11.40		10.00		8.10	11.30	.....	.....	.....	.....	190	188	.....	.....	.....	.....	12	13	10	12
Colorado	12.50		12.50		7.80	8.10	.....	.....	.....	.....	70	120	150	.....	.....	.....	12	11	9	8
New Mexico	13.00		.....		10.20	10.80	.....	.....	.....	.....	100	140	.....	.....	5.0	....	13	12	11	10
Arizona	.....		.....		10.60	.....	.....	.....	.....	.....	.....	235	.....	.....	.....	.....	.....	12	7	....
Utah	8.50		9.00		7.70	8.00	.....	.....	.....	.....	75	110	.....	.....	.....	.....	12	11	7	8
Nevada	.....		.....		.....	.....	.....	.....	.....	.....	145	185	.....	.....	.....	.....	12	11	....	8
Idaho	11.00		9.20		7.50	10.20	.....	.....	.....	.....	85	100	.....	.....	.....	.....	14	12	10	10
Washington	12.70		11.20		11.30	10.20	.....	.....	.....	.....	64	107	.....	.....	.....	.....	13	13	11	9
Oregon	11.70		8.30		9.10	8.00	.....	.....	.....	.....	90	100	.....	.....	.....	.....	12	11	10	9
California	9.20		10.00		8.50	7.00	.....	.....	.....	.....	88	110	50	.....	4.8	....	12	12	8	8
United States	14.28		13.36		9.32	7.86	2.26	1.80	23.33	23.37	73.1	123.0	84.7	124.5	4.4	4.7	13.7	13.7	11.0	11.4

TABLE 12.—*Prices paid to producers of farm products, by States*—Continued.

FEBRUARY 15.

States.	Maple sugar, per pound.	Maple sirup, per gallon.	Hops, per pound.		Beans, per bushel.		Cabbages, per 100 pounds.		Onions, per bushel.		Sweet potatoes, per bushel.		Turnips, per bushel.		Broom corn, per ton.		Pop corn, per bushel.	
	1915	1915	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Dls.*	*Dls.*	*Dls.*	*Dls.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Dls.*	*Dls.*	*Dls.*	*Dls.*
Maine	....	100	....	....	3.55	2.85	1.45	1.87	89	115	....	....	49	51	....	....	....	1.75
New Hampshire	14.8	111	....	....	3.49	2.75	1.40	1.88	90	130	....	....	55	57	....	....	2.67	3.07
Vermont	9.8	102	....	....	3.40	2.80	1.50	2.50	80	125	....	....	47	49	....	....	1.82	2.50
Massachusetts	....	97	....	....	3.25	4.00	1.00	1.72	72	150	....	....	51	55	....	....	2.65	2.10
Rhode Island	....	....	....	....	3.25	2.30	1.05	1.55	76	122	....	....	52	68	....	....	2.75	2.10
Connecticut	....	....	....	....	3.50	2.95	1.25	1.90	70	142	....	....	42	49	....	....	1.25	2.80
New York	12.1	100	10	....	3.18	2.31	.60	1.45	75	122	....	....	41	47	....	....	1.49	2.45
New Jersey	16.0	....	....	....	3.67	2.45	1.30	1.97	64	110	105	75	55	42	....	....	.90	1.50
Pennsylvania	13.3	94	....	....	3.40	2.49	1.50	2.30	90	110	125	110	56	46	....	....	1.25	1.20
Delaware	....	....	....	....	3.50	2.60	1.92	1.00	93	125	100	60	49	33	....	....	1.33	1.50
Maryland	....	....	....	....	3.12	2.85	1.62	1.75	100	95	....	....	60	....	....	....	....	....
Virginia	16.0	105	....	....	3.03	2.61	1.90	2.40	107	110	85	86	42	43	....	....	1.00	1.02
West Virginia	14.7	117	....	....	3.24	2.83	2.00	2.50	120	120	110	150	53	55	....	....	1.40	1.50
North Carolina	....	....	....	....	2.95	2.38	1.40	2.39	95	92	79	75	44	43	....	....	1.41	1.17
South Carolina	....	....	....	....	2.88	2.75	2.10	2.42	130	150	85	85	75	75	....	....	1.61	1.50
Georgia	....	....	....	....	2.65	2.75	2.10	2.45	125	145	80	85	60	100	....	....	1.47	1.50
Florida	....	....	....	....	2.86	2.70	2.50	2.97	138	190	78	80	52	62	....	....	....	....
Ohio	15.0	105	....	....	3.15	2.40	1.70	2.25	85	125	105	140	49	65	....	....	1.80	1.55
Indiana	14.0	130	....	....	3.15	2.32	1.75	2.40	80	140	105	121	45	48	....	....	1.60	1.67
Illinois	....	130	....	....	3.13	2.55	1.80	2.60	100	150	110	125	47	70	85	135	2.10	1.90
Michigan	....	123	....	....	2.99	1.70	.90	1.80	65	100	....	....	34	37	....	....	1.03	1.15
Wisconsin	17.0	135	....	....	2.79	2.10	1.30	1.70	95	130	....	....	41	53	....	....	1.56	1.75
Minnesota	....	....	....	....	2.80	2.10	2.00	2.75	105	130	....	....	46	50	....	....	1.73	1.90
Iowa	15.0	138	....	....	3.50	2.60	2.00	3.30	105	150	....	180	70	90	....	....	1.84	1.40
Missouri	17.6	90	....	....	3.03	2.70	2.40	3.00	125	165	110	140	41	52	74	95	1.61	1.80
North Dakota	....	....	....	....	3.10	2.79	3.05	3.25	145	170	....	....	60	47	....	....	2.35	3.00
South Dakota	....	....	....	....	3.34	2.70	3.00	3.94	150	160	....	....	75	84	....	....	1.90	1.71
Nebraska	....	....	....	....	3.09	2.60	2.00	3.05	130	160	....	194	54	81	....	40	1.70	1.60
Kansas	....	....	....	....	3.23	2.80	2.40	3.05	130	180	....	150	55	60	60	79	1.75	1.98
Kentucky	18.9	150	....	....	3.10	2.57	2.00	2.67	110	120	100	110	40	54	....	....	1.28	1.50
Tennessee	17.2	115	....	....	2.78	2.65	2.20	2.78	105	110	98	100	43	55	....	145	1.44	1.67
Alabama	....	....	....	....	3.13	2.50	1.90	2.50	140	145	80	83	75	75	....	....	1.62	1.95
Mississippi	....	....	....	....	2.35	....	2.40	3.47	125	150	71	77	65	80	....	....	2.17	2.10
Louisiana	....	....	....	....	2.90	....	2.60	2.35	100	150	62	65	....	55	....	....	1.50	....
Texas	....	....	....	....	3.09	2.80	2.15	2.75	165	175	105	110	85	75	58	76	2.26	2.10
Oklahoma	....	....	....	....	3.24	2.50	2.60	3.00	175	160	110	115	70	59	73	93	2.00	2.90
Arkansas	....	....	....	....	3.20	2.85	2.70	3.30	125	140	95	100	49	55	....	....	1.54	1.35
Montana	....	....	....	....	3.50	3.35	1.75	2.20	100	195	....	....	62	78	....	....	3.08	2.38
Wyoming	....	....	....	....	3.34	3.35	2.20	2.70	185	215	....	....	98	90	....	....	2.05	2.25
Colorado	....	....	....	....	2.63	2.05	1.30	1.70	85	150	....	....	48	56	63	65	2.24	1.89
New Mexico	....	....	....	....	2.60	2.60	2.00	2.55	170	215	165	168	110	112	52	80	1.96	2.65
Arizona	....	....	....	....	3.20	2.85	2.00	3.00	....	....	155	....	95	120	....	....	....	....
Utah	....	....	....	....	3.42	3.00	1.90	2.35	125	190	....	....	55	110	....	....	2.24	....
Nevada	....	....	....	....	....	....	2.50	3.00	130	210	....	....	92	125	....	....	....	....
Idaho	....	....	....	....	2.80	2.40	2.80	2.60	125	145	....	....	56	55	....	....	....	1.66
Washington	....	....	10	....	3.20	3.00	1.80	2.60	100	180	....	....	54	60	....	....	....	....
Oregon	....	....	12	18	3.25	2.80	2.40	2.35	100	160	....	....	80	55	....	....	....	....
California	....	....	....	22	3.00	2.55	1.30	1.50	85	150	105	167	60	70	....	....	....	....
United States	11.6	106.2	11.1	19.1	3.02	2.09	140.8	2.07	97.6	140.7	85.0	86.1	51.1	60.0	78.44	95.16	1.78	1.73

TABLE 12.—*Prices paid to producers of farm products, by States*—Concluded.

State.	Prices paid to producers, Feb. 15.						Prices paid by producers, Feb. 15.									
	Clover seed, per bushel.		Timothy seed, per bushel.		Alfalfa seed, per bushel.		Clover seed, per bushel.		Timothy seed, per bushel.		Alfalfa seed, per bushel.		Bran, per ton.		Cotton-seed meal, per ton.	
	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914
Me.	.....	.....	.....	.....	.....	.....	$12.30	$11.50	$3.80	$3.25	.....	.....	$31.70	$29.30	$35.00	$35.30
N. H.	.....	.....	.....	.....	.....	.....	11.05	12.25	3.85	3.40	.....	$9.00	30.70	29.20	34.30	35.40
Vt.	.....	.....	.....	.....	.....	.....	11.20	11.00	4.25	3.40	.....	.....	30.80	28.10	34.70	34.50
Mass.	.....	$10.00	.....	$2.75	.....	.....	14.00	12.00	4.60	3.10	.....	.....	30.70	29.50	34.70	34.50
R. I.	.....	.....	.....	.....	.....	.....	.....	12.00	.....	.....	.....	.....	30.60	28.50	33.70	33.40
Conn.	.....	.....	.....	3.50	.....	.....	12.00	13.00	3.90	3.75	.....	.....	31.00	28.80	34.00	34.00
N. Y.	$10.20	9.50	$3.55	2.79	$10.60	$8.70	11.15	10.50	4.00	3.10	$11.30	9.60	30.30	27.70	33.80	35.00
N. J.	.....	.....	.....	2.85	.....	.....	10.85	10.50	3.90	3.10	11.50	10.00	31.20	28.50	34.40	35.40
Pa.	8.94	9.00	3.14	2.55	7.75	9.00	10.30	10.00	3.65	3.10	10.60	10.05	30.20	28.10	34.40	34.40
Del.	8.50	10.00	3.20	3.50	.....	9.50	.....	11.00	3.50	3.82	.....	9.50	34.70	29.80	31.30	35.00
Md.	.....	.....	.....	.....	.....	.....	.....	9.80	.....	3.15	.....	.....	30.30	28.80	32.00	33.50
Va.	9.75	9.55	3.35	2.75	.....	.....	10.50	10.45	3.50	3.05	10.50	9.25	30.30	28.50	31.00	33.50
W. Va.	9.70	10.00	3.38	3.10	.....	10.40	11.00	10.30	3.90	3.20	10.75	10.10	31.20	29.80	34.90	35.30
N. C.	9.85	10.40	3.40	3.27	.....	.....	10.40	10.60	3.40	3.60	.....	.....	32.30	31.80	30.30	33.40
S. C.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33.20	31.30	28.40	30.10
Ga.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14.70	.....	32.30	30.80	29.40	30.30
Fla.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34.30	31.30	31.70	32.90
Ohio.	8.55	8.10	2.95	2.29	9.10	8.10	9.65	9.15	3.50	2.80	10.45	9.05	30.40	28.40	33.20	34.00
Ind.	8.60	8.00	3.05	2.50	9.30	8.20	9.75	9.10	3.70	3.00	10.50	9.00	29.10	27.50	32.60	34.60
Ill.	9.15	8.50	3.05	2.40	10.00	8.80	10.30	9.50	3.60	2.70	10.80	9.50	27.20	26.40	31.30	30.90
Mich.	8.30	7.80	3.00	2.40	9.40	7.90	10.00	9.15	3.70	3.00	10.50	8.90	30.00	27.70	33.80	34.50
Wis.	7.65	7.50	2.65	2.15	8.40	8.70	8.75	8.65	3.25	2.60	10.20	9.90	27.10	25.10	34.10	34.00
Minn.	7.80	7.60	2.50	2.05	.....	.....	9.70	9.40	3.10	2.70	12.00	12.00	27.50	23.30	35.30	33.50
Iowa.	9.00	8.20	2.65	2.00	9.60	7.60	9.75	9.40	3.10	2.30	11.00	8.70	27.00	25.30	32.80	32.70
Mo.	10.10	8.90	3.10	2.80	10.00	8.90	10.80	9.80	3.60	3.40	10.70	9.80	27.00	25.80	29.90	31.00
N. Dak.	10.10	8.00	2.95	3.00	12.00	.....	12.10	.....	3.50	2.75	12.10	.....	25.80	20.80	36.00	28.50
S. Dak.	9.10	9.00	2.50	2.00	8.70	8.60	12.00	9.25	3.50	4.50	11.00	10.50	26.50	22.70	31.30	33.00
Nebr.	9.00	8.25	2.81	2.75	8.10	6.70	10.50	10.00	3.50	3.00	9.70	7.00	25.00	23.60	33.00	33.60
Kans.	9.00	8.20	3.05	2.50	7.20	5.60	10.50	9.80	3.75	3.00	7.75	6.35	24.10	24.40	30.10	32.10
Ky.	9.80	9.60	3.45	2.85	9.95	9.30	10.60	10.10	3.60	3.00	10.10	9.20	28.60	28.90	30.50	32.50
Tenn.	10.40	9.00	3.25	3.00	10.30	9.50	11.30	10.20	3.80	3.00	11.10	9.50	29.40	29.60	30.00	32.30
Ala.	.....	.....	.....	.....	.....	.....	.....	12.80	.....	3.80	.....	11.75	31.10	30.50	29.00	31.00
Miss.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32.00	30.20	29.10	30.50
La.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31.40	28.60	28.70	30.00
Tex.	.....	.....	.....	.....	.....	7.20	.....	.....	.....	.....	9.60	7.90	30.60	29.60	28.20	31.30
Okla.	.....	.....	.....	.....	8.00	6.50	.....	.....	.....	.....	9.20	8.10	27.10	26.90	27.50	30.80
Ark.	.....	11.65	.....	.....	.....	10.00	11.40	11.00	3.90	3.35	10.80	10.20	28.50	28.00	27.60	29.20
Mont.	9.40	.....	2.25	.....	9.00	10.00	10.00	.....	2.80	.....	10.20	.....	27.70	22.00	38.00	22.00
Wyo.	.....	.....	.....	2.55	8.05	7.10	.....	.....	.....	.....	9.50	8.15	27.00	22.60	39.50	22.60
Colo.	.....	.....	.....	.....	8.00	7.45	.....	.....	.....	.....	9.60	7.60	27.80	25.00	31.20	35.60
N. Mex.	.....	.....	.....	.....	9.00	8.00	.....	.....	.....	.....	10.00	9.30	31.50	30.30	33.60	36.20
Ariz.	.....	.....	.....	.....	.....	6.90	.....	.....	.....	.....	.....	.....	42.00	43.00	.....	39.70
Utah.	.....	.....	3.10	2.58	7.50	5.05	9.50	.....	3.90	.....	8.40	.....	27.20	19.50	.....	19.50
Nev.	.....	.....	.....	.....	7.30	7.30	.....	.....	.....	.....	7.50	9.75	37.60	32.00	.....	32.00
Idaho.	8.20	7.30	2.24	1.80	8.00	6.60	9.50	8.90	2.95	2.75	9.90	8.75	28.00	23.50	38.00	.....
Wash.	10.50	.....	.....	.....	.....	.....	11.90	12.00	4.20	5.00	12.20	12.60	32.60	24.00	41.40	39.33
Oreg.	7.50	7.45	2.60	.....	9.90	7.50	9.50	9.20	3.00	.....	.....	11.00	29.20	24.20	33.60	36.30
Cal.	.....	.....	.....	.....	7.80	7.00	.....	.....	.....	.....	9.70	9.00	32.50	27.80	27.00	33.70
U. S.	8.60	8.07	2.66	2.12	7.86	6.48	10.22	9.77	3.56	2.94	9.29	7.98	28.96	26.91	30.88	32.59

TABLE 13.—*Averages for the United States of prices paid to producers of farm products.*

Product.	February 15—					March 15—		January 15—		
	1915	1914	1913	1912	1911	1914	1913	1915	1914	1913
Hogs.....per 100 lbs..	$6.34	$7.75	$7.17	$5.79	$7.04	$7.80	$7.62	$6.57	$7.45	$6.77
Beef cattle.....do....	5.93	6.16	5.55	4.61	4.57	6.28	5.88	5.99	6.04	5.40
Veal calves.....do....	7.62	7.90	7.23	6.07	6.38	7.92	7.49	7.66	7.89	7.06
Sheep.....do....	5.14	4.67	4.03	4.01	4.34	4.77	4.97	4.95	4.67	4.35
Lambs.....do....	6.67	6.18	6.34	5.15	5.44	6.31	6.56	6.47	6.18	6.03
Milch cows.....per head..	57.99	59.09	51.42	43.40	44.48	59.23	54.02	58.48	57.99	49.51
Horses.....do....	132.00	139.00	146.00	137.00	144.00	138.00	146.00	130.00	137.09	140.00
Chickens.....per lb..	.113	.120	.112	.....	.....	.124	.115	.109	.115	.107
Eggs.....per doz..	.237	.258	.212	.....	.....	.222	.170	.217	.208	.241
Honey, comb.....per lb..	.127	.137	.139	.140	.133	.127	.139	.126	.136	.139
Honey, extract.....do....	.110	.114	.123	.123	.118	.111	.119	.111	.112	.122
Wool, unwashed.....do....	.202	.157	.187	.163	.173	.164	.184	.186	.157	.186
Walnuts, black.....per bu..	.85	.....	.....	.....	.....	.....	.....	.82	.77	.68
Hickory nuts.....do....	1.24	.....	.....	.....	.....	.....	.....	1.19	1.30	1.13
Peanuts.....per lb..	.044	.047	.045	.047	.050	.047	.047	.045	.047	.046
Apples.....per bu..	.73	1.23	.78	.99	1.19	1.29	.82	.69	1.11	.74
Maple sugar.....per lb..	.116	.....	.122	.....	.....	.124	.125	.....	.....	.....
Maple sirup.....per gal..	1.06	.....	1.06	.....	.....	1.10	1.06	.....	.....	.....
Beans.....per bu..	3.02	2.09	2.19	2.38	2.26	2.05	2.10	2.63	2.17	2.26
Beans, soy.....do....	2.26	1.80	.....	.....	.....	.....	.....	2.35	1.96	.....
Sweet potatoes.....do....	.85	.86	.87	.94	.82	.87	.91	.81	.82	.84
Turnips.....do....	.51	.60	.51	.....	.....	.....	.....	.49	.57	.59
Onions.....do....	.98	1.41	.78	1.49	1.04	1.55	.77	.89	1.21	.82
Cabbages.....per 100 lbs..	1.41	2.67	1.17	2.24	1.48	2.03	1.03	1.36	1.87	1.26
Timothy hay.....per ton..	14.26	.....	.....	.....	.....	.....	.....	14.07	.....	.....
Clover hay.....do....	13.36	.....	.....	.....	.....	.....	.....	13.07	.....	.....
Alfalfa hay.....do....	9.32	.....	.....	.....	.....	.....	.....	9.48	.....	.....
Prairie hay.....do....	7.86	.....	.....	.....	.....	.....	.....	7.65	.....	.....
Clover seed.....per bu..	8.60	8.07	10.28	12.22	8.37	8.17	10.42	8.51	7.99	9.41
Timothy seed.....do....	2.66	2.12	1.78	7.26	4.51	2.30	1.72	2.63	2.07	1.79
Alfalfa seed.....do....	7.86	6.48	8.15	.....	.....	6.60	8 19	7.61	6.55	7.66
Broom corn.....per ton..	78.00	95.00	56.00	86.00	80.00	91.00	57 00	66.00	94.00	49.00
Pop corn.....per bu..	1.78	1.73	1.54	.....	.....	.....	.....	1.65	1.72	1.47
Cotton seed.....per ton..	23.33	23.87	22.01	16.81	25.61	23.60	21.55	18.97	22.70	21.98
Hops.....per lb..	.111	.191	.169	.388	.178	.205	.....	.146	.266	.197
Paid by farmers:										
Clover seed.....per bu..	10.32	9.77	11.62	.....	.....	9.45	12.30	10.34	9.82	11.39
Timothy seed.....do....	3.56	2.94	2.47	.....	.....	2.97	2.33	3.42	2.90	2.51
Alfalfa seed.....do....	9.29	7.98	9.60	.....	.....	8.01	9.78	8.79	8.30	8.25
Bran.....per ton..	28.96	26.91	25.32	28.62	25.27	27.58	24.96	27.90	26.53	25.24
Cottonseed meal.....do....	30.88	32.59	31.16	30.87	31.42	32.65	31.08	29.56	32.49	30.97

Product.	March 1—					April 1—		February 1—		
	1915	1914	1913	1912	1911	1914	1913	1915	1914	1913
Wheat.....cts. per bu..	133.6	88.1	86.6	90.7	85.4	84.2	79.1	129.9	81.6	79.9
Corn.....do....	75.1	69.1	52.2	66.6	48.9	70.7	53.7	72.8	68.3	50.6
Oats.....do....	52.1	38.9	33.1	49.8	32.8	39.5	33.1	50.1	39.3	32.4
Barley.....do....	67.7	51.1	49.0	91.6	63.0	51.7	48.5	62.9	52.4	51.4
Rye.....do....	105.4	61.9	63.2	84.0	71.9	68.0	62.9	100.5	61.7	68.9
Buckwheat.....do....	85.5	75.1	67.0	76.9	64.1	76.9	68.3	83.7	75.6	69.4
Potatoes.....do....	50.4	70.5	52.0	102.6	55.3	70.0	50.3	50.4	69.7	53.1
Flaxseed.....do....	157.9	132.5	119.0	183.9	240.7	132.8	113.6	163.7	127.8	109.3
Hay.....dols. per ton..	11.71	12.37	11.34	15.69	12.09	12.20	11.15	11.69	12.41	11.64
Butter.....cts. per lb..	26.8	26.0	27.5	27.2	22.7	24.9	27.6	27.9	27.4	27.6
Eggs.....cts. per doz..	21.3	24.2	19.4	24.5	16.5	17.6	16.4	20.2	28.4	22.8
Chickens.....cts. per lb..	11.7	11.7	11.1	10.5	10.6	12.3	11.6	11.5	11.6	10.9
Cotton.....do....	7.4	12.6	11.8	9.8	13.9	11.9	11.8	7.4	11.9	11.9

TABLE 14.—*Range of prices of agricultural products at market centers: Statement for February, 1915.*

Product and market.	Feb. 1, 1915.	Jan., 1915.	Dec., 1914.	Jan., 1914.	Jan., 1913.
Wheat per bushel:					
No. 2 red winter, St. Louis	$1.53½–$1.55½	$1.27½–$1.52	$1.12½–$1.27½	$0.93 –$0.99½	$1 03 –$1.155
No. 2 red winter, Chicago	1.54½– 1.58	1.26½– 1.53	1.13½– 1.28½	.95⅝– .98½	1.07½– 1.1⅝
No. 2 red winter, New York[1]	1.64 – 1.68	1.37½– 1.62	1.24½– 1.35½	1.00 – 1.02	1.07 – 1.11
Corn per bushel:					
No. 2 mixed, St. Louis	.78 – .78	.69 – .77	.62 – .68½	.63½– .68	.45 – .51
No. 2, Chicago	.77½– .78	.68½– .77	.62½– .68¼	.60 – .66	.46½– .50½
No. 2, mixed, New York[1]	.87 – .88¼	.83 – .86¼	.....	.71 – .77	.54½– .57¾
Oats per bushel:					
No. 2, St. Louis	.58 – .58⅜	.49 – .57½	.46½– .50	.38½– .47½	.33 – .35
No. 2, Chicago	.59½– .60	.49 – .58⅜	.46¾– .49⅜	.37⅝– .39	.32 – .33½
Rye per bushel: No. 2, Chicago	1.27½– 1.28½	1.11½– 1.26½	1.07½– 1.12½	.60 – .62	.62 – .65½
Baled hay per ton: No. 1 timothy, Chicago	15.00 –16.00	15.00 –17.50	15.00 –16.00	13.50 –17.50	13.00 –19.00
Hops, per pound: Choice, New York	.....	.....	.23 – .28	.45 – .48	.26 – .32
Wool per pound:					
Ohio fine unwashed, Boston	.24 – .25	.23 – .25	.23 – .24	.20 – .21½	.24 – .24
Best tub washed, St. Louis	.33 – .34	.31 – .34	.31 – .32	.28 – .28	.37 – .37
Live hogs per 100 pounds: Bulk of sales, Chicago	6.75 – 6.85	6.40 – 7.20	6.90 – 7.50	7.75 – 8.60	7.25 – 7.65
Butter per pound:					
Creamery, extra, New York	.33½– .33½	.32 – .36	.33 – .36½	.26 – .37½	.33½– .38
Creamery, extra, Elgin	.31½– .31½	.30 – .34	.32 – .34	.28½– .35½	.32 – .34
Eggs per dozen:					
Average best fresh, New York	.29 – .29	.30 – .44	.41 – .62	.34 – .50	.27 – .40
Average best fresh, St. Louis	.26 – .26	.28½– .37½	.27 – .35	.27 – .31	.21 – .25
Cheese per pound: Colored,[2] New York	.16½– .16⅝	.15½– .16½	.14½– .15	.16½– .17½	.16½– .17⅝

[1] F. o. b. afloat.
[2] September colored—September to April, inclusive; new colored May to July, inclusive; colored August.

TABLE 15.—*Range of prices of agricultural products at market centers: Statement for March, 1915.*

Product and market.	Mar. 1, 1915.	Feb., 1915.	Jan., 1915.	Feb., 1914.	Feb., 1913.
Wheat per bushel:					
No. 2 red winter, St. Louis	$1.47 –$1.48	$1.45 –$1.64	$1.27½–$1.52	$0.91 –$0.95½	$1.00 –$1.13
No. 2 red winter, Chicago	1.47 – 1.50½	1.45½– 1.68	1.26½– 1.53	.93½– .97½	1.02 – 1.12
No. 2 red winter, New York[1]	1.58 – 1.63	1.58 – 1.80	1.37½– 1.62	1.01 – 1.05½	1.09½– 1.11½
Corn per bushel:					
No. 2 mixed, St. Louis	.70 – .70½	.68½– .78	.69 – .77	.64 – .66½	.47½– .50½
No. 2, Chicago	.70 – .72	.68½– .78	.68½– .77	.61 – .63½	.49 – .51½
No. 2 mixed, New York[1]	.77 – .79	.75½– .88¾	.83 – .86½	.68 – .70½	.56 – .58½
Oats per bushel:					
No. 2, St. Louis	.56 – .59	.55 – .60	.49 – .57½	.39½– .43	.33 – .35
No. 2, Chicago	.53 – .56	.53 – .60	.49 – .58⅜	.38½– .39½	.32½– .34½
Rye per bushel: No. 2, Chicago	1.16 – 1.17	1.15 – 1.31	1.11½– 1.26½	.60½– .64	.58 – .65
Baled hay per ton: No. 1 timothy, Chicago	15.00 –16.00	15.00 –16.00	15.00 –17.50	15.00 –16.00	13.00 –15.00
Hops, per pound: Choice, New York	.....	.....	.....	.43 – .46	.25 – .28
Wool per pound:					
Ohio fine unwashed, Boston	.28 – .29	.24 – .29	.23 – .25	.21 – .22	.24 – .24
Best tub washed, St. Louis	.31 – .31½	.30 – .35	.31 – .34	.28 – .28	.35 – .37
Live hogs per 100 pounds: Bulk of sales, Chicago	6.60 – 6.75	6.35 – 7.00	6.40 – 7.20	8.20 – 8.90	7.75 – 8.60
Butter per pound:					
Creamery, extra, New York	.23 – .23½	.24 – .30	.32 – .36	.26½– .32	.35 – .38
Creamery, extra, Elgin	.29 – .29	.29 – .32	.30 – .34	.26½– .30	.33 – .35
Eggs per dozen:					
Average best fresh, New York	.40 – .40	.33 – .40	.30 – .44	.29 – .40	.24 – .32
Average best fresh, St. Louis	.18½– .18¾	.20 – .28	.28½– .37½	.24½– .28	.17½– .23
Cheese per pound: Colored,[2] New York	.16¾– .17	.16½– .17½	.15½– .16½	.16¾– .17½	.16½– .17½

[1] F. o. b. afloat.
[2] September colored—September to April, inclusive; new colored May to July, inclusive; colored August.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 666 APRIL 22, 1915.

Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.

FOOT-AND-MOUTH DISEASE.[1]

By JOHN R. MOHLER, V. M. D.,
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NATURE AND CHARACTERISTICS.

Foot-and-mouth disease, also known as aphthous fever, epizootic aphtha, and eczema contagiosa, is an acute, highly communicable disease chiefly confined to cloven-footed animals and characterized by an eruption of vesicles or blisters on the mucous membrane of the mouth and on the skin between the toes and above the hoofs. The vesicles rupture, forming erosions and ulcerations; there are also salivation, tenderness of the affected parts, loss of appetite, lameness, emaciation, and diminution in the quantity of milk secreted.

The tremendous ravages of the disease are seen in the number and variety of the species attacked. While it may be regarded as essentially a disease of cattle, hogs would seem to be as easy a prey. Almost in the same grade of receptivity are sheep and goats. Next in order of susceptibility come the buffalo, American bison, camel, chamois, llama, giraffe, and antelope. Horses, dogs, cats, and even poultry may occasionally become infected with the disease, the last three being particularly dangerous as carriers of the contagion. Man himself is not immune, and the frequency of his infection by coming in contact with diseased animals is established by numerous observations.

As with other communicable diseases, the source and origin of foot-and-mouth disease have given rise to much speculation. The disease had been known in Europe for centuries, but it was not until comparatively recent years that the erroneous conceptions of its spontaneous origin as a result of climatic and meteorological conditions, exhausting journeys, etc., were abandoned. It is now conceded that foot-and-mouth disease is propagated by a specific virus and that every outbreak starts from some preexisting outbreak.

[1] This bulletin is largely a revision of the department's earlier publications on the subject. It is intended for general distribution.

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Investigators have so far been unable to identify or isolate the specific organism causing the disease, although numerous attempts have been made to cultivate and stain it by laboratory methods. Experiments have shown that the virus will pass through standard germ-proof filters, thus indicating its minute size and the reason it has not been detected by the staining methods. The contagion may be found in the serum of the vesicles on the mouth, feet, and udder; in the saliva, milk, and various secretions and excretions; also in the blood during the rise of temperature.

A wide distribution of the virus and a rapid infection of a herd is the result. Animals may be infected directly, as by licking, and in calves by sucking, or indirectly by such things as infected manure, hay, utensils, drinking troughs, railway cars, animal markets, barnyards, and pastures. Human beings may carry the virus on their shoes and clothing and transmit it on their hands when milking, since the udder is occasionally the seat of the eruption. It may also be carried by dogs, cats, rats, chickens, pigeons, etc. Milk in a raw state may also transmit the disease to animals fed with it.

The observations made by some veterinarians would lead us to suppose that the virus is quite readily destroyed. It is claimed that stables thoroughly cleaned become safe after drying for a short time. Hence, litter of all kinds, such as manure or soiled hay and straw, may remain infective for a longer time because they do not dry out. Other authorities maintain that the virus is quite tenacious and may live in stables even so long as a year. They also state that animals which have passed through the disease may be a source of infection for several months after recovery.

Unlike most other infectious diseases, foot-and-mouth disease may attack the same animals repeatedly. No definite immunity is conferred by an attack.

The period of incubation (that is, the time elapsing between the exposure of an animal to infection and the development of the disease in that animal) is variable, usually from three to six days. The disease may appear in 24 hours, or, in exceptional cases, not for 18 days or even longer.

LOSSES.

The highly contagious character of foot-and-mouth disease and its rapid spread to practically all exposed susceptible animals lead to heavy losses. Since the mortality is comparatively low, ranging from only 3 per cent or less in mild forms to 30 or 40 per cent in malignant cases, the havoc caused by the pestilence is sometimes underestimated. But there are other sources of loss which are much more important than the actual mortality. The fever and the difficulty of eating cause a rapid and extreme loss in flesh and a lessening or cessation of the milk secretion. The udders often become inflamed and ruined by the formation of abscesses, and cows affected in this way are sometimes rendered permanently valueless for

milk production. The inflammation of the feet may cause the horn to drop from the toes, producing great lameness and lasting injury. Abortion is frequent with pregnant animals, and typical lesions have been observed in the newly born at birth. Altogether these losses may amount to 20 or 30 per cent of the value of affected animals.

In addition there are indirect losses of a commercial nature. Dairy farmers are put out of business for a time. Necessary quarantine restrictions greatly interfere with the movement of live stock and such commodities as hay, straw, hides, and farm produce. The business of the stockyards and slaughtering centers is greatly interfered with. Sometimes it is necessary to close stockyards for disinfection. The whole business of marketing, transporting, feeding, and slaughtering is interrupted and deranged. Losses of this character may reach enormous proportions.

THE DISEASE IN OTHER COUNTRIES.

Foot-and-mouth disease has prevailed in Europe for a great many years and has occasioned tremendous economic losses there.

In Italy, France, Switzerland, Germany, and Russia the plague has existed so long and has gained such a foothold that it is economically impossible to fight it with the American methods of slaughter and disinfection, for to do so would be to kill a large percentage of the live stock of those countries. In consequence, little or no progress toward eradication has been made by the authorities, though the severity of the disease in France appears to have abated somewhat in recent months.

The outbreak which appeared in Germany in 1888 increased steadily until 1892, when it diminished gradually for a few years, but the disease again reached great proportions in 1899. Thereafter it continued to exist to a greater or less extent until in 1911 it attained a virulence unequaled before. In that year 3,366,369 cattle, 1,602,927 sheep, 2,555,371 hogs, and 53,674 goats were affected. At that time the total number of cattle, sheep, swine, and goats in Germany was only 51,319,000, while there were in the United States 172,572,000, or between three and four times as many. It can readily be imagined, therefore, what it would mean to the United States if the disease were to gain the foothold here that it had in Germany, where, as these figures show, approximately one out of seven of the animals susceptible to the disease was affected.

The German Government, of course, has not left the disease to itself. It attempted to control recent outbreaks by the method of slaughter, but the pestilence had gained too much headway and was too firmly established in too many portions of the country for this method to succeed, and the slaughter of the infected herds had to be abandoned. It now appears that there is no hope of getting rid of it until the virus has worn itself out. As soon as the animals' period of acquired immunity is over and favorable conditions present themselves, the contagion breaks out with renewed virulence. It has been impossible to control it by means of quarantines. One

scientist has asserted that unless all the infected farms were absolutely isolated and the movement not only of live stock but of persons absolutely prohibited, the disease could not be stamped out. Such a quarantine is, of course, utterly impossible to enforce. In portions of Germany the farmers, realizing that the disease is inevitable, make haste to be done with it by exposing their stock deliberately to mild cases in the hope that this will result in an immediate mild attack and immunity for several years thereafter. Such immunity, however, is very uncertain.

Great Britain, Denmark, Norway, and Sweden, on account of their comparatively isolated positions, have been more successful in keeping out the disease. The outbreaks in these countries have been more sporadic, and by resorting to immediate slaughter the authorities have been able to stamp them out. Great Britain has applied both quarantine and slaughter for many years, and in an outbreak near Dublin in 1912 measures were adopted which were even more stringent than any that have been used in the United States. A British official (Cope) asserted in 1899 that after his country's experience with this disease it was "more dreaded by the farmers and stock raisers of Great Britain than cattle plague or pleuropneumonia, and they are now willing and ready to put up with any restrictions, of however drastic a character, considered necessary by the central department to stamp it out." The British authorities have succeeded in suppressing each outbreak, but reinfection often occurs from the neighboring continent. Great Britain has been reported as free of the disease for a few months up to the time this is written (March, 1915). Sweden is now reported as affected.

In November, 1906, the disease reached Belgium from France, where it was quite prevalent, and by the end of the year every Province in Belgium was affected, and the Netherlands as well. Efforts to eradicate it from Belgium were unavailing. The Netherlands apparently succeeded in stamping it out for about six months, but it has reappeared there.

The disease is also more or less prevalent in Austria-Hungary, Spain, and in the Balkan countries.

Australia and New Zealand have remained free from it.

We have less accurate information regarding Asia and Africa, but the disease is known to prevail in Japan and China and in the Philippine Islands, and it is doubtful if any considerable part of the Orient is free from it.

In South America it is reported as common in Brazil, Argentina, and Uruguay, and it probably exists in other countries.

Canada and Mexico are fortunately free from the disease.

OUTBREAKS IN THE UNITED STATES.

Foot-and-mouth disease has appeared in the United States on six different occasions—1870, 1880, 1884, 1902, 1908, and 1914.

An extensive outbreak in 1870 was introduced by way of Canada, where the infection was brought by an importation of cattle from Scotland. It spread into the New England States and New York and appears to have been arrested within a few months. Its failure to spread more extensively and its early disappearance have been ascribed to favorable conditions, such as the movement of live stock from west to east, the limited trading at that period as compared with the present time, the restriction of traffic by winter weather, and the infrequency of travel which obtained at that time among people.

About 1880 there were two or three lots of animals brought to the United States affected with this disease, but there was no extension from the animals originally affected.

In 1884 there was a small outbreak at Portland, Me., caused by imported cattle, and the disease spread to a few herds outside of the quarantine station. Owing to the small number of animals affected and the limited area of territory covered by the disease, it was easily controlled by the ordinary measures of quarantine and disinfection.

It will be observed that in all of these early outbreaks the contagion was introduced with imported animals. Since the development of a stringent system of inspection and quarantine of imported live stock no instance of that kind has occurred. On subsequent occasions the infection has evidently been brought in with contaminated products or materials and not by means of live animals.

In November, 1902, the disease was discovered in Massachusetts and Rhode Island. The earliest cases were traced to Chelsea, Mass., near the docks, and it was suspected for a time that the infection was brought in with foreign shipping, by some such means as hay, straw, halters, ropes, hides, hair, wool, etc. Later developments, however, and especially investigations into the cause of the 1908 outbreak, led to the belief that a more probable source of the infection was cowpox vaccine virus imported from a country where foot-and-mouth disease existed (probably Japan), the vaccine virus being contaminated with the virus of foot-and-mouth disease.

A Federal quarantine was declared by the Secretary of Agriculture on November 27, 1902, as soon as the nature of the disease was established, and steps for eradication were at once taken by the Bureau of Animal Industry of the United States Department of Agriculture in cooperation with authorities of the affected States. The methods followed consisted of inspection to trace and detect the disease, quarantine of infected premises and territory, slaughter and burial or burning of diseased and exposed animals, and disinfection of premises,

This outbreak involved Massachusetts, New Hampshire, Vermont. and Rhode Island. It was eradicated in about six months. There were found infected 244 herds including 4,712 cattle. Of these, 205 herds with 3,872 cattle, as well as 360 hogs and 220 sheep and goats, were slaughtered. The cattle infected but not slaughtered were those that either died or completely recovered before slaughtering

could be carried out. The animals slaughtered were valued at $184,155.10, and the Federal Government reimbursed owners to the extent of 70 per cent, or $178,908.57. It is understood that the States paid the remainder. The total cost to the Department of Agriculture of stamping out the disease was about $300,000.[1]

The next appearance of foot-and-mouth disease was early in November, 1908, when it was observed in cattle near Danville, Pa. A Federal quarantine was issued November 12. The infection was traced back to the stockyards at East Buffalo, N. Y., and to Detroit, Mich. The disease appeared in the States of Michigan, New York, Pennsylvania, and Maryland. A careful and thorough investigation

FIG. 1.—Cow affected with foot-and-mouth disease characterized by salivation and by lesions on teats and around coronet of right hind foot.

made by the writer in conjunction with Dr. M. J. Rosenau of the Public Health Service demonstrated that the outbreak started from calves used to propagate vaccine virus at an establishment near Detroit, and that the source of the infection was contaminated Japanese vaccine virus.[2]

Vigorous measures of eradication similar to those employed in 1902–3 were at once put into effect and the disease was stamped out

[1] A history of the outbreak of 1902–3 appears in the Nineteenth Annual Report of the Bureau of Animal Industry (for 1902), page 391.

[2] A report of this investigation was published as Bureau of Animal Industry Circular 147. A history of the 1908 outbreak was given in the Twenty-fifth Annual Report of the Bureau of Animal Industry (for that year), page 379. It may be remarked that the importation and the domestic manufacture of vaccines and other biological products are now under Government supervision, those intended for use in human medicine being looked after by the Public Health Service and those for veterinary use by the Bureau of Animal Industry.

in about five months at an expense to the Department of Agriculture of about $300,000 and to the States of about $113,000. The inspectors made 108,683 visits to farms, stockyards, etc., and inspected over a million and a half animals (including reinspections). One hundred and fifty-seven premises were found infected, and 3,636 animals (2,025 cattle, 1,329 hogs, and 282 sheep and goats), valued at $90,033.18, were slaughtered. Owners were reimbursed for the value of their animals and property destroyed, one-third being paid by the States and two-thirds by the Federal Government.

FIG. 2.—Head of cow affected with foot-and-mouth disease.

The latest invasion was discovered in the vicinity of Niles, Mich., in October, 1914, after it had evidently been underway since August of the same year. This is the most serious and extensive outbreak ever known in this country. At the time this is written (March, 1915), the disease has been found in 21 States and the District of Columbia, at places ranging from the Atlantic to the Pacific coasts. The work of eradication has not been completed at this writing, though it is well advanced and the epizootic seems to be under control. The affected States are Connecticut, Delaware, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Montana,

New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Virginia, Washington, West Virginia, and Wisconsin. Illinois has had the largest infected area and the largest number of animals affected. Next in order come Pennsylvania, Michigan, and Ohio. The Union Stock Yards at Chicago became infected and were a source of dissemination of the contagion north, east, south, and west. These and other yards found infected were closed temporarily and disinfected.

The first Federal quarantine was issued October 19, 1914. A campaign to check the spread of the disease and to stamp it out was immediately begun by the United States Department of Agriculture in cooperation with the State authorities. Quarantines against the movement of animals and certain materials from the infected areas were declared, shipments were traced, rumors investigated, and thorough inspections made in an effort to discover all infected stock. As measures of eradication, diseased herds are being slaughtered and buried and the premises disinfected. The owners of live stock and other property destroyed on account of the disease are reimbursed to the extent of the appraised value, half of which is paid by the Federal Government and half by the State.

SYMPTOMS.

In three to six days or even longer after the exposure of the animal to the infection the disease makes its appearance. It is usually first indicated by the animal suffering from a chill, quickly followed by an invasion of fever, which may cause the temperature to rise as high as 106° F. These symptoms are not always present, or may be in so slight a form as to escape notice. Following this in one or two days it will be noticed that small vesicles or blisters about the size of hemp seeds or a pea are making their appearance upon the mucous membranes of the mouth at the border and upper surface of the tongue near the tip, the inside of the cheeks, on the gums and the inner surface of the lips, or on the margin of the dental pad. These little blisters contain a yellowish watery fluid and gradually become more extensive as the disease advances. Soon after the eruptions have appeared in the mouth of the animal it will be noticed that there is considerable swelling, redness, and tenderness manifest about the feet, at the coronet and between the digits of each foot. Eruptions similar to those within the mouth make their appearance upon these swollen regions of the foot a day or two later, and at this stage it is usual to find that like lesions have made their appearance upon the perineum of the victim. In the case of milch cows, the udder, and more particularly the teats, show the same vesicular eruption, but the latter as the result of milking soon become covered with reddened spots deprived of the superficial layer of skin and may develop deep, obstinate fissures.

As soon as the disease has become well established the patient evinces pain when attempting to eat; in fact the appetite is often

so seriously affected that all food is refused and the animal uneasily opens and shuts its mouth with a characteristic smacking sound, while strings of cohesive, ropy saliva hang suspended from the lips. With the advance of the disease the vesicles have widened and extended until they may reach a diameter ranging from that of a dime to that of a silver dollar. These rupture soon after their appearance, sometimes on the first day, more rarely on the second or third day. After they have ruptured the grayish white membrane forming the blister may remain attached for a day or more, or disappear speedily and leave deeply reddened sensitive spots or erosions, both within the mouth and upon the coronet and between the claws of the feet. Similar erosions, which quickly form scabs as a rule, may

FIG. 3.—Blisters and scabs of foot-and-mouth disease on teats.

be noticed in cases in which the teats of milch cows have become affected, and instances are reported in which sloughing of the tegument immediately around the lesions upon the udder has occurred. Owing to the tough, fibrous nature of the bovine skin, it is exceedingly rare for sloughing to occur upon any part of the body other than those mentioned.

The attack upon the feet of an animal is frequently manifested in all four feet at once, but one or more of the feet may entirely escape and remain unaffected throughout the course of the disease. The ulceration of the interdigital tissue may extend to the ligaments of the fetlock or produce disease of the joint or bone. As the feet become sensitive and sore the animal lies down persistently, and it has been found that bed sores develop with amazing rapidity in all

such cases and wholly baffle all attempts at treatment until after the patient has regained its feet.

The disease may attack some of the internal organs before it appears upon any of the external tissues. These cases are very liable to prove quickly fatal. The animal dies from paralysis of the heart, due to the formation of poisonous principles within the system, or it may suffocate by reason of the action of these same poisons upon the tissues of the lungs, or it may choke to death as a result of paralysis of the throat.

In cases of serious affection of the udder the erosions will often be found located within the passages of the teats, resulting in a "caked" udder, and the same toxic poisoning which is the cause of death in the apoplectiform types just mentioned may arise from this source. In any event the milk from such cases will be found dangerous for use, causing fatal diarrhea in sucking calves or young pigs and serious illness in human consumers. The milk obtained from cows suffering with foot-and-mouth disease is not readily converted into either butter or cheese, but remains thick, slimy, and inert in spite of churning and attempts at curdling. Pregnant animals may abort. In pigs, sheep, and goats the lesions in the foot are most common, but both forms may be observed or only the mouth lesions.

FIG. 4.—Lesions of foot-and-mouth disease on feet of cow.

When the disease has become fully established it will be found that the duration of the attack will vary greatly with different animals. From 10 to 20 days are usually required for the recovery of the normal appetite and spirits in mild outbreaks, while the return to a full flow of milk, in the case of milch cows, is seldom witnessed before the arrival of the following season.

In the malignant type of the disease it requires from three months to a year for an animal to recover. The mortality, as already stated, is usually low. The disease is more fatal in young animals that have been fed on infected milk, and produced death in from 60 to 80 per cent

of these cases as a result of gastro-enteritis. In the present outbreak numerous new centers of infection have been started among hogs and calves which were fed on unpasteurized infected milk from creameries.

DIAGNOSIS.

The recognition of this affection should not, as a rule, be difficult, especially when the disease is known to be in the vicinity; in fact, the group of symptoms form a clinical picture too decided to be doubted. The combination of high fever, vesicular inflammation of the mouth, and hot, painful, swollen condition of the feet, followed 24 to 48 hours later by the appearance of numerous blisters varying in size from that of a pea to that of a walnut on the udder and feet and in the mouth should prevent any serious or long-continued error in the diagnosis. However, in the inoculation of calves we have a certain and final test. In 24 to 96 hours after inoculation the calves present the characteristic blisters. Such inoculation should be practiced, however, only by officials who are properly authorized to deal with contagious diseases.

HOW TO DISTINGUISH FOOT-AND-MOUTH DISEASE FROM OTHER AFFECTIONS.

The lesions of no other disease of cattle closely simulate the vesicular eruption of foot-and-mouth disease on the lining membrane of the mouth. When the blisters have ruptured, however, and the resulting lesions have become contaminated by numerous secondary forms of microorganisms, the correct recognition of the disease may be involved in considerable difficulty.

Cowpox or horsepox may be accidentally transmitted by inoculation. But the eruption of the "pox" goes on to the development of a pustule, while in foot-and-mouth disease the eruption is never more than a vesicle, even though the contained fluid may become turbid. The inoculation test in the case of cowpox does not respond with fever and eruption for at least 10 days, and often longer.

Necrotic stomatitis (sore mouth due to a germ) may be distinguished from foot-and-mouth disease by the fact that in the latter disease there is a rapid infection of the entire herd, including the adult cattle, as well as the infection of hogs and sheep. The characteristic lesion of foot-and-mouth disease is the appearance of blisters containing a serous fluid upon the mucous membrane of the mouth and upon the udder, teats, and feet of the affected animals. In necrotic stomatitis blisters are never formed, destruction of the tissues occurring from the beginning and being followed by the formation of yellowish, cheesy patches principally found involving the lining membrane of the mouth, especially the tongue and cheeks.

In mycotic stomatitis (sore mouth due to a fungus or mold), portions of the lining membrane become inflamed and in a few days it changes to a croupous membrane which peels off, leaving a raw surface, while the thin skin between the toes may also be inflamed. The

previous history of the case; the failure of the blisters, if any appear, to spread extensively; the absence of vesicular eruptions on other portions of the body, notably the udder and teats, and, characteristically, the hoof, together with the absence of rapid spread to practically all cattle in the herd and the complete negative character of inoculation of calves, distinguishes between the local disease named and foot-and-mouth disease. Mycotic stomatitis occurs in only from 10 to 50 per cent of the animals in a herd, usually in the late summer or early fall after a dry spell, and it does not run a regular course.

The lesion, resulting from ergotism may be distinguished from those of foot-and-mouth disease by the lack of eruptions in the mouth and

FIG. 5.—Inspectors examining cow for foot-and-mouth disease. They are equipped with rubber coats, gloves, boots, and hats, which are cleansed with disinfectants after each examination, in order to avoid spreading the contagion.

by the location of the disease at the tips of the ears, end of the tail, or upon the lower part of the legs, usually below the knees or hocks The lesion of ergotism does not take the form of pustules or blisters, but manifests itself first as a swelling about the ankle, which later may slough and circumscribe the limb, forming a deep crack, extending entirely around the limb and forming a distinct line of demarcation between the healthy skin above and the diseased below. The absence of ulcerous sores on the coronet and between the claws, together with the healthy condition of the membranes of the mouth and the knowledge that the lesion upon the limb in question extends uninterruptedly around it, should point conclusively to a diagnosis of ergotism and to the exclusion of all fears of foot-and-mouth disease.

In foul foot or ground itch of cattle, the inflammation of the skin and toes is general and not in certain spots, as in foot-and-mouth disease; the mouth remains unaffected and the presence of the disease may be traced to filth and poor drainage.

The severer forms of the disease might be confounded with certain general diseases. Where gastro-intestinal symptoms predominate acute gastric catarrh or inflammation of the intestines might be thought of. Involvement of the lungs might lead to a diagnosis of acute congestion of the lungs or pneumonia. The distinction is apparent in these diseases by the lack of vesicular eruption on the mucous membrane or skin, and also by lack of evidences of infection in the herd or neighboring animals.

PREVENTION AND ERADICATION.

The measures to be adopted to prevent the spread of the affection must take into consideration the highly infectious nature of the disease, its ease of dissemination, and the liability of the virus to live outside of the body of an animal for long periods. Great care should therefore be observed in keeping healthy animals unexposed to the contagion. When an outbreak occurs in a community, the owner should make every effort to keep other animals from coming in contact with his diseased cattle. This especially applies to dogs, cats, goats, and poultry, which usually have access to the stables and barnyards and in this way furnish excellent means for disseminating the infectious principle. He should be equally particular in prohibiting any person from coming onto his premises, especially an attendant or owner or other person in any way connected with cattle. Such a herd may be placed under quarantine, with an inspector appointed to keep the premises under constant surveillance.

This method of quarantine alone, while very satisfactory in many instances, is rather tardy in obtaining the desired result. The experience of European governments, already mentioned, shows that eradication by this method alone, when the disease has obtained a foothold, is practically impossible. For this reason when the disease breaks out in a country like the United States, where the contagion is likely to spread rapidly by means of infected cars, manure, hay, and other feed, and where the results of its obtaining a firm foothold would be so disastrous, it seems that this method of temporizing is rather tedious, and more radical steps are required in order to suppress and eradicate completely the infection in the quickest and most thorough manner possible.

It would therefore appear better to concentrate the expense incident to the extermination of foot-and-mouth disease by purchasing and slaughtering all affected and exposed cattle after judicious appraisement. The carcasses of these animals should be totally de-

stroyed, preferably by cremation, or otherwise by burying them in a hole 6 feet deep and covering them with air-slaked lime. The infected stable should be disinfected by thoroughly cleaning it, scrubbing the floor with hot water, brushing down all loose dust from the walls, and tearing off all woodwork which is partly decayed. Then the whole interior of the stable should be disinfected with one of the following substances:

A 5 per cent solution of pure carbolic acid.

Chlorid of lime, U. S. P. strength (30 per cent available chlorin), 1 pound to 3 gallons of water.

Formaldehyde, 1 quart 40 per cent solution to 5 gallons of water.

FIG. 6.—Method of slaughtering and burying cattle. The trench is deep enough to allow carcasses to be covered with at least 5 feet of dirt. Animals are led to trench and there killed, usually by shooting. Hides are slashed to prevent anyone from exhuming carcasses in order to get the hides, and carcasses are cut open and covered with quicklime.

A 3 per cent solution of cresol compound, U. S. P., or accepted substitute therefor, containing at least 50 per cent cresylic acid.

All stable utensils should be thoroughly cleaned and disinfected by the application of a solution of one of the above disinfectants. The manure should be burned or disinfected and spread over ground (other than meadow land) that is to be turned under. No other cattle should be purchased for at least sixty days after the complete disinfection of the premises.

The success in eradicating the disease by combined quarantine, slaughter, and disinfection, as practiced in the United States, Denmark, Great Britain, and a few other countries, demonstrates in a striking manner the efficacy of slaughtering and the futility of relying upon quarantine alone in stamping out the disease.

Inoculation has been adopted in some countries in order to have the disease spread quickly through the herds, and while this practice has undoubted value where the disease is indigenous, it is not desirable in this country and should not be adopted.

As a rule medical treatment with a view to curing affected animals is not to be recommended under conditions prevailing in the United States, where the disease has not become established, and the first object is to stamp it out as quickly as possible. Even though most animals would recover, with or without treatment, it would be practically impossible, while they were being held for recovery, to prevent the spread of the infection to others. The disease would be likely to spread faster than it could be cured. As already pointed out, it has been found impossible to prevent absolutely the spread of the contagion by the strictest quarantine alone, under the usual farm conditions. In addition, the affected animals that have passed through the disease may become a source of further infection as virus carriers for weeks and months after they have apparently recovered, and are susceptible of reinfection as one attack does not confer permanent immunity.

FOOT-AND-MOUTH DISEASE IN MAN.

Foot-and-mouth disease is primarily and principally a disease of cattle; secondarily and casually, a disease of man. It is transmissible to man through the eating or drinking of raw milk, buttermilk, butter, cheese, and whey from animals suffering from foot-and-mouth disease. It is also transmitted directly, though more rarely, from the salivary secretions or other infected material which may gain entrance through the mucous membrane of the mouth. It is doubtful whether the disease can be transmitted to man by cutaneous or subcutaneous inoculation, though it is probable that the infection may be communicated if the virus directly enters the blood through wounds of any kind. Children are not infrequently infected by drinking unboiled milk during the periods in which the disease is prevalent in the neighborhood, while persons in charge of diseased animals may become infected through contact with the diseased parts or by milking, slaughtering, or caring for the animals.

The symptoms in man resemble those observed in animals. There is fever, sometimes vomiting, painful swallowing, heat and dryness of the mouth, followed by an eruption of vesicles on the mucous membrane of the mouth, and very rarely by similar ones on the fingers. The vesicles appear on the lips, gums, cheek, and edge of the tongue, and are about the size of a pea. The vesicles soon rupture, leaving a small erosion which is soon covered by a thin crust under which the new formation of epithelium proceeds rapidly. The skin eruption mostly appears on the hands, tips of the fingers, base of the nails, and more seldom on the toes and other parts of the body. Besides these local changes, during the course of the disease there are occa-

sionally observed headache, pain in the limbs, vertigo, abdominal cramps, vomiting, diarrhea, and weakness. The disease is very seldom fatal, usually appearing in a very mild form except in weakened children, in whom an accompanying intestinal catarrh may lead to a fatal termination.

Veterinarians who have had considerable experience with the disease among animals regard the human affection as by no means uncommon in countries where foot-and-mouth disease prevails, but the disturbance of health is usually too slight to come to the notice of the family physician.

But few outbreaks of the disease have occurred in the United States, and therefore cases of its transmission to man in this country are quite rare. Dr. James Law reports having observed the disease in man

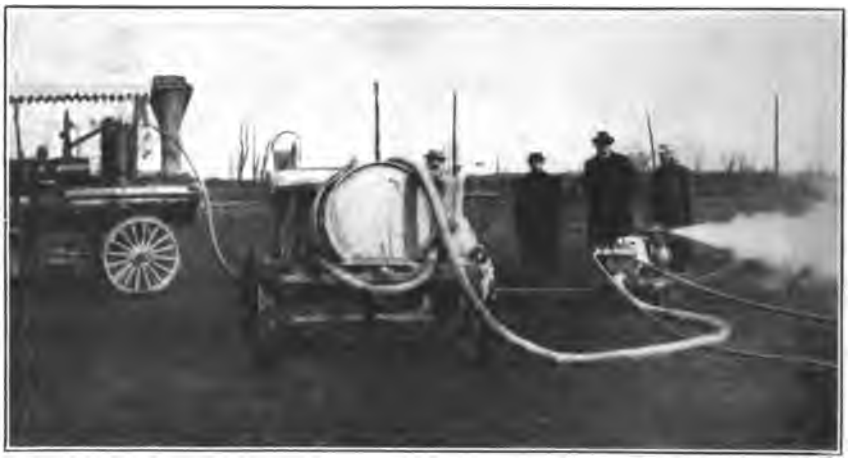

FIG. 7.—Outfit for disinfecting on a large scale. The tank contains 5 per cent chlorinated lime solution, which is sprayed by a steam pump, steam being supplied by a traction engine.

from drinking infected milk during the epizootic of 1870 in the Eastern States, but the outbreaks of 1880 and 1884 affected such a small number of animals and were so quickly suppressed that no instance of its transmission to man was recorded. A few cases have been reported by Brush accompanying the New England outbreak of 1902. Similar reports have been likewise received concerning the appearance of vesicular eruptions in the mouths of children during the 1908 and 1914 outbreaks, and the history of these cases incriminates the milk supply.

Experiments by Loeffler and Froesch, as well as recent experiments which have been made in Denmark and Germany, indicate that the infection is comparatively easy to destroy by heat or the usual antiseptics. Milk pasteurized at a temperature of 60° C. for 20 minutes is safe so far as infection by foot-and-mouth disease is concerned.

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BREAKING AND TRAINING COLTS.

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INTRODUCTION.

The breaking and training of colts is of prime importance, because their future value and usefulness depends to a great extent on whether or not they are well broken. By a broken colt is meant one that is safe to handle in the stable or on the road and that will promptly obey the orders of the driver or rider.

Memory and habit are the two main factors with which we have to deal in training horses. A horse acts through instinct and habit, and one of its greatest characteristics is uniformity of conduct. What a horse is once trained to do he will nearly always do under like conditions.

The first thing in training a horse is to get his attention. The second is to make him understand what is wanted. The education of the horse is based on reward and punishment. The reward, a pat on the neck, etc., should immediately follow the act of obedience. The punishment, to be effective, must immediately follow the act of disobedience.

Few horses are inherently vicious. Many horses are made vicious and unreliable by the carelessness or unnecessary brutality of their trainers. If a horse kicks because the harness hurts him, or shies at something of which he is afraid, punishment is not justifiable. If, however, after being stopped, a horse starts before receiving the command to do so, he should be punished. Horses are naturally obedient, and when thoroughly trained their conduct is uniformly good.

A horse should be trained so that he thinks there is no limit to his power to do the things required of him, and believes that he has no power to do that which is against the wishes of his driver. Above all, never ask of a horse something he is unable to perform and then punish him because it can not be done. If during the first year of his work a colt is hitched only to loads that he can pull, he will develop into a good work horse, while if he is overloaded a few times he may become balky and worthless.

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All horses can not be treated alike. A high-strung, sensitive horse must be treated gently, the dullard sharply. The same force applied to the sensitive horse that is necessary to make the dullard act would be likely to cause the high-strung horse to rebel, while gentleness would obtain obedience.

To train horses successfully a man needs to exercise great patience, gentleness, and firmness. If you are training a horse and lose your temper, you had better put the horse into the stable until the next day, for further work at this time will be worse than useless and may undo the work already done.

AGE TO BREAK.

Horses are broken at ages ranging from weanlings to old horses. The instincts in a horse which are opposed to obedience to man increase in strength with age. This accounts for the difficulty encountered in handling range horses that are allowed their freedom until their instinct of independence is so strongly developed that it is proportionately difficult to teach them that it is their duty to obey some force other than their own instinct.

FIRST STEPS IN BREAKING.

It is a great advantage to begin the education of the colt as early as possible. The plan generally followed is to break the colt to being led and handled before it is weaned, and to break to harness between the ages of 2 and 3 years. Colts should not do heavy work until they are 4 years old, and should be accustomed to it gradually.

Before a colt is broken to being led it should be taught to stand tied; this applies to unbroken horses of all ages. To do this, put a strong halter on the colt; then take a rope about 14 feet long, double it, putting the loop under the horse's tail as a crupper, twist the two ropes together about three times, then let one rope come forward on each side of the horse, and tie the ends together in front against the chest just tight enough so that it will not drop down; then run a surcingle loosely around the horse behind the withers, tying into it the crupper rope at both sides. Have an additional rope about 12 feet long, run it through the halter ring, and tie it at the breast to the rope that forms the crupper. Tie the other end of the rope to a solid post, allowing about 3 feet of slack. (See fig. 1.) Leave the colt tied for an hour. Another method is to have a loop in one end of the rope, run the lead strap through this loop, and tie it with a little slack to the rope that forms the crupper, the other end of the additional rope, of course, being tied to a solid post.

GENTLING THE COLT.

While tied the colt should be gentled and accustomed to being handled on both sides, on the hind parts, and on the legs. To do this,

hold the headstall in one hand and with the other hand gentle (that is, pet and rub) the colt, first on the neck and head, then on the back and sides, and last on the legs.

To gentle the hind parts take a stick about 4 feet long, wrap a gunny sack around one end, and tie it. Allow the colt to examine it with his nose. Then rub it all over his body.

With this arrangement the colt's hind legs may be rubbed without placing one's self in danger of his heels. If he kicks at it do not hit him, but allow him to examine it again, and proceed as before. This lesson should continue until the colt will stand being approached from either side and rubbed all over. The second day he may be tied

FIG. 1.—Arrangement of halter and ropes for breaking a colt to stand tied and to lead.

up again and further gentled with sacks, blankets, and noises until he has no fear of them around him, under him, or upon him.

Another method of gentling a horse is to tie the halter rope to the tail, as shown in figure 2. This forces him to go in a circle. When he gives in and stands quietly he may be harnessed, saddled, mounted, accustomed to strange sights and sounds, and handled with safety. This is one of the best aids in use in gaining a horse's submission.

BREAKING TO LEAD.

The horse is now ready to lead. Loosen the rope from the post, step off from the horse, and tell him to "come," following the command with a pull on the rope. As soon as the horse advances pet him,

then step away and repeat. He will soon follow without the pull on the rope. Half an hour's leading and this lesson is over.

The next day the crupper should be put on at the beginning of the lesson, but should be discarded after a short work-out and the halter alone used so that the colt will not depend on the crupper rope. These lessons should be continued until the colt leads satisfactorily. If a colt is still running with his mother, it is a good idea, as soon as he is broken to lead, to tie his halter rope to the mother's trace if she is being worked. The tie should be made at about the union of

FIG. 2.—One method of gentling a colt.

the backband and the trace and short enough to prevent the colt from getting in front of the team. This will acquaint him with the general conditions and noises pertaining to work, and on account of the mother being so near he will soon become familiar with such surroundings and lose his fear of them.

To break to lead without crupper ropes use a strong halter with a lead rope. Step back about 6 feet from the colt, opposite his shoulders, cluck to him, and pull on the rope. The colt will be forced to take a couple of steps; reward him; cross in front to a similar position on the other side and repeat the command with a pull. Con-

tinue the lesson until the colt follows. Never pull straight ahead on the colt; he can outpull you. Use diplomacy rather than force.

HANDLING AND TRIMMING A HORSE'S FEET.

If the owner will accustom a colt to having his feet handled at the same time he is broken to lead—that is, before he is weaned—much future work and trouble will be avoided. Untrimmed hoofs usually grow long and uneven, and a crooked foot, or worse, a crooked leg, is the result. Failure to regulate the length and bearing of the foot may make a straight leg crooked or a crooked leg worse, while intelligent care during the growing period can greatly improve a leg that is crooked at birth. If horses' feet were properly cared for, there would be fewer knock-kneed, bow-legged, pigeon-toed, cow-hocked, interfering, and paddling horses.

When picking up a colt's foot teach him to stand on three legs, and not to depend on the one holding up his foot for the fourth point of support. When handling a colt's feet begin with the near front foot. Tie a rope around the pastern, grasp the rope close to the foot, push gently against the shoulder, and quickly lift the foot. The lifting of the foot must be simultaneous with the weight shifting to the other feet. Gentle the foot and leg and let it down. Repeat several times and then trim and level the hoof.

To raise a hind foot, put on a rope as on the front foot and draw the foot forward. To put a rope on the hind foot of a wild horse, tie up a front foot, have the assistant hold his hand over the eye on the same side as the foot to be lifted, or take the headstall in one hand, the tail in the other, and whirl the horse until he becomes dizzy. While in this condition he may be handled with safety. Lift the foot forward two or three time and gentle it. As soon as the horse gives in, carry the foot backward into a shoeing position and trim the hoof.

To handle the feet of a horse that will not stand still, or that kicks, a halter twitch is a great aid. (See Fig. 3.) This twitch is easily applied and needs only the ordinary halter and tie rope. Pass the rope over the horse's head just behind the ears; raise the upper lip and put the rope across the gums above the teeth; run the rope through the loop made by passing the rope over the horse's head. The rope should be tight from the halter ring, over the head, under the lip, and through the loop. A few good pulls on this rope should make the horse stand quietly.

For a kicker try the following: Buckle a strap with a 2-inch ring around hind pastern, run a rope through this ring and carry end up over horse's back, tie to opposite foreleg next to the body, and lead the horse forward. When he lifts his foot it may be held up by pulling on the loose end of the rope, as shown in figure 4. The foot may

be held either forward or backward with this arrangement. (See also fig. 5.) The best time to work on a horse's feet is when he is tired from a drive or other exercise.

BREAKING TO DRIVE.

After the colt has been broken to lead he may be accustomed to harness and trained to rein. A horse should never be hitched to a wagon or ridden before he is broken to drive in harness; that is, trained to go at command, stop when he hears "whoa," rein to the right and left, and to back up.

To familiarize the colt with bit and harness the "bitting harness," consisting of an open bridle with snaffle bit, check and side reins, and

FIG. 3.—Halter twitch.

surcingle with crupper, may be used. The bitting harness is shown in figure 6.

Put the rigging on the colt, leaving the side and check reins comparatively loose, and turn him loose in a small paddock for an hour. On the second lesson the reins may be tightened somewhat, but not left on for over an hour. The third day driving lines may be put on. Let the assistant lead the colt till he is not frightened at the driver walking behind. Dismiss the assistant as soon as possible, and drive the colt for half an hour in a quiet paddock or lane where he will not see other horses. All that should be taught in this lesson is to go ahead. Cluck to the colt, or tell him "get up," and use the whip to let him know what is meant.

It is essential to train both sides of a colt. He may become accustomed to objects seen on the near side with the near eye, but when the same objects are viewed for the first time on the other side with the off eye he may be badly frightened. Driving in a right and left circle will facilitate this training.

TO STOP A HORSE—"WHOA."

The next lesson should be a short review of the previous work and in addition the meaning of "whoa." "Whoa" in horse training is the big word. It doesn't mean back or steady, but stop. Train the

FIG. 4.—Raising the hind foot.

horse so that when he hears "whoa" he will stop and stay stopped no matter what is happening.

To stop a horse say "whoa" so that he hears you plainly, and immediately follow the command with a pull on the reins. The most effective use of the reins is to hold one rein just tight and give a good reef or pull on the other one, then relax the pressure. If the horse doesn't stop, repeat the command and pull. Soon he will stop at the word, and the pull may be eliminated.

TO BACK A HORSE—"BACK."

The next lesson should review "get up" and "whoa," and the horse should be taught to back. As a horse should be trained to stop on command, so should he back on the word, and lugging on the lines should be unnecessary.

Drive the horse a few steps to get his attention, stop him, then give the command "back," following it with a good reef on the reins. If he yields a step, pet him, and then repeat the command with the pull on the reins. Do not exert a continuous pressure, for if this is done the horse will take the bit and forge ahead. Do not make the lesson too long. Repeat again the next day, and continue lessons until the horse will back on command.

After the horse goes satisfactorily in bitting rig, the work harness with breeching should be substituted. The traces and breeching should be joined loosely together and gradually tightened as the work progresses. This will familiarize the colt with the sensation

FIG. 5.—Holding foot for shoeing.

of wearing collar and breeching. As soon as he goes well with the harness he is ready to be hitched to the wagon or cart, single or double.

DRIVING DOUBLE.

To drive double use a broken gentle horse for a team mate, preferably one that the colt knows. Hitch them together and drive around without the wagon, stopping, starting, and backing the team. Thirty minutes should suffice for this lesson.

At the next lesson familiarize the colt with the wagon; lead him up to it, allowing him to smell it. Then rattle the wagon and lead him around it; lead the gentle horse to its place at the tongue, bring the colt up, attach the lines, the neck yoke, and lastly the traces.

Hitch the two together. The assistant may now take the colt's lead rope. Drive a few steps and stop, using the brake to prevent the wagon from running up on the team. Let the assistant pet the colt until he quiets down, then start again, going a little farther. As soon as the colt gets over his fear drive around in a circle a few times. Stop occasionally and always quiet the colt. Circle in the opposite direction. When the colt goes quietly the assistant may get in the wagon. Have a short stay chain on the old horse so that if necessary he may start the wagon alone. After the colt goes well a short drive may be taken. Always stop when the colt shows fear of something. Let him look it over and examine it; never whip him or rush by

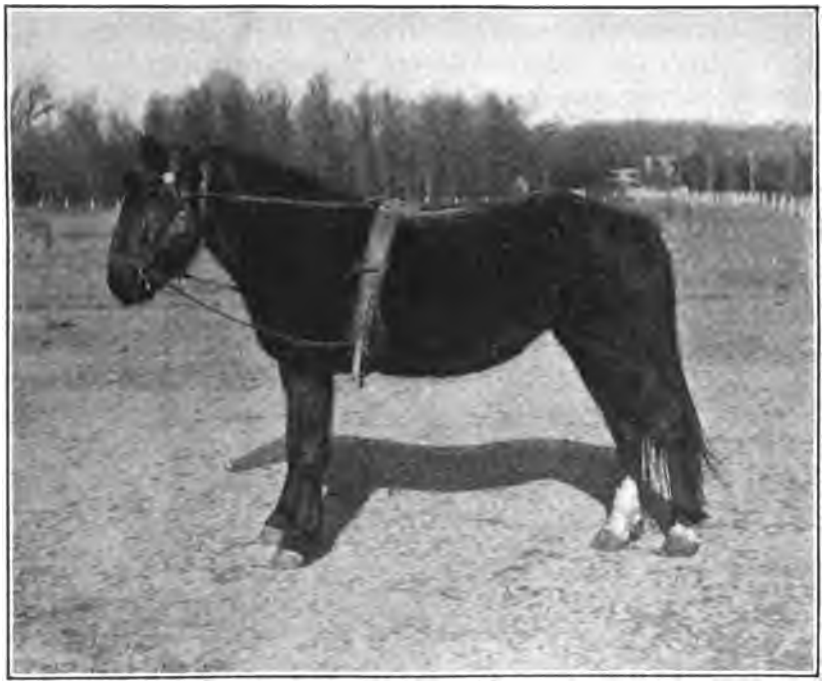

FIG. 6.—Bitting harness.

anything at which he is frightened; otherwise a shying horse will result. The daily drive may be increased in length until the colt is broken.

CITY SIGHTS.

Before the colt is driven in the city or on a road where there is heavy traffic he should be accustomed to such sights and sounds as will be encountered there. If a railroad track is near, where trains pass frequently, or a road with automobile traffic, or a traction engine in action, put on the leading ropes and tie the colt near. As soon as he loses his fear of such sights and sounds at a distance he should be led up to them if possible and allowed to make an examination. When he finds that they do not hurt him he loses his fear and may then be driven on busy roads and streets.

DRIVING SINGLE.

Put single harness on the colt, using an open bridle. Lead him to the rig and allow him to examine it. A two-wheeled breaking cart with long shafts is usually used. Let the assistant draw the rig around the colt a few times, or until the colt does not shy at it; then raise the shafts and draw the rig into place. If the colt is one that you think may kick or try to run, put on the trip ropes. (Fig. 7.)

Some horses are confirmed kickers, runaways, or otherwise unsafe to handle with the ordinary appliances. With trip ropes such horses may be handled with safety and cured of many bad habits. To put on trip ropes a strong surcingle, four 2-inch iron rings, two straps to go around pasterns, and a rope about 25 feet long are needed. Fasten two 2-inch rings to the underside of the surcingle and put straps with rings on front feet. Run end of rope through near ring on surcingle, through ring on near foot, up and through off side surcingle ring, down, and tie to off fore foot. A pull on the rope when the horse steps will bring him to his knees. This appliance may also be used to teach a horse the meaning of "whoa." Always use knee pads or have the horse on soft ground, where he will not injure his knees.

When the colt is hitched the driver should get in the rig and have the assistant lead the colt. Start him quietly, drive a few steps, stop and pet him. Repeat until he starts and stops the rig without becoming frightened. Dismiss your assistant as soon as possible so that the colt's attention may not be divided between two authorities. Before the colt is driven on busy highways he should be "city broke."

BREAKING TO RIDE.

When a horse is to be used for riding it is well first to break him to drive single and double. This will make him quieter to ride.

Horses usually buck through fear. In breaking one to ride, take plenty of time and do not frighten him. Put on the saddle and lead him around until he becomes accustomed to it. Do not have the girth too tight. The horse may be tied up for a time and later turned into a paddock with the saddle on.

Next accustom the horse to being mounted, getting on and off a number of times. (See Fig. 8.) The assistant should have a lead rope tied around the horse's neck and run through the rings of a snaffle bit. If the horse attempts to play up, punish him with a jerk on the bit. Let the assistant lead the horse with rider around until the horse is familiar with the weight on his back, then dismiss the assistant. If the horse becomes rebellious, pull his head sharply to one side; do not let him get it down. The first few rides should be in a small inclosure.

The gaits should be taught separately. The first few rides should be the walk; next teach the trot, and then the canter. Spurs should

not be used until the horse is well broken. Most saddle horses can be taught to rack. To teach a horse to rack, he should be shod with light shoes or none at all in front and heavy shoes behind. Sitting well back in the saddle, just force the horse out of a walk and he will soon rack. Keep him at it for only a short distance at a time, as it is a new gait to him and tiresome at first. After the gait is learned the duration of the lesson may be gradually lengthened.

SUGGESTIONS.

In the preceding instructions principal emphasis has been laid on kindness to the horse. In reality the whip is of equal importance with kindness. To be submissive to a man's will, the horse must fear

FIG. 7.—Trip ropes.

the consequences of disobedience. There will be clashes, but the horse must be convinced that man is his master. Always, if the horse can not do or be made to do what is asked of him, make him do something else. As long as he is not allowed to do what he himself chooses he will consider man his superior and master.

Never work a colt after he is tired. By heeding this precaution you prevent obstinacy and render him a willing and obedient pupil.

Training should be given in a quiet place, where the colt's attention will not be distracted from the work in hand by other horses or strange surroundings.

Whenever two people are working with a horse they should be on the same side. The horse's attention is then undivided, and if he plunges or kicks he may be controlled with less danger to the trainers.

To harness or saddle a horse it is customary to approach his near or left side, also to mount from the left side.

Never approach a horse without first gaining his attention. Always speak to him before attempting to walk into a stall with him.

BAD HABITS.

Horses that have been properly handled and trained are not balky, neither do they have bad habits. When horses with bad habits

FIG. 8.—Mounting a horse.

are encountered a careful study of each case should be made in order to ascertain the cause, and, if possible, to remove it.

BALKINESS.

The most common cause of balkiness among horses is punishment to make them do something that they can not do or that they do not understand how to do. Another common cause is the forcing of horses to draw heavy loads without allowing them to stop occasionally to rest and regain their breath. The use of the whip or spur in such instances should be avoided, as the pain inflicted will be very likely to provoke further and more stubborn rebellion. If a horse balks the bearing of the harness should be examined to see if it is hurting him. If a heavy load is being drawn and the horse is not

allowed to rest and regain his breath and strength he may become sulky and refuse to pull. Give him a short rest, and while he is resting rub his nose, pick up a front foot and tap the hoof a few times, or adjust the harness, and he may forget his grievance. Take the lines and give the command to go ahead, turning slightly to the right or left to start. If the horse does not start it is either a case of overload or a chronic balker. If the load is so heavy it can not be drawn, unload. If the horse is a chronic balker a course of training will be necessary to overcome the habit.

In older horses where the habit of balking is fixed the horse should be trained to obey all commands with promptness without being hitched to the wagon. First put on the double trip ropes and use them until the horse stops and stands when he hears "whoa." Next put on the guy line, which should be managed by an assistant, while you drive and attend the trip ropes. The guy line is a rope fastened around the horse's neck and a half hitch over the lower jaw. It is very severe and should not be used to excess. If the horse shows any tendency to balk, give the command "whoa" before he stops of his own accord. When ready to start, the assistant should take a position in front of the horse and smartly jerk him forward with the guy line at the same time you give the command "get up." Repeat the process of stopping and starting until the horse shows no signs of self-will. Use the guy line, and use it severely, on the slightest intimation that the horse is going to balk. After a few of these lessons the horse may be hitched to the wagon. The trip ropes and guy line should be kept on until he is well broken of the habit.

KICKING.

A horse that kicks when something touches his heels is dangerous to drive. To overcome the habit, put on the harness and the trip ropes. Take a stick and pole him all over, as described under "Breaking to lead." After he becomes submissive to the pole, tie sacks of hay to the traces and breeching, and continue the lesson until he pays no attention to them.

Fasten a long pole on either side with one end to drag on the ground, the other end to be fastened to the shaft carrier. Drive him around with these, and if he attempts to kick command "steady" and pull him to his knees. The lessons should be continued until he submits to the poles dragging between his legs and all round him. This is a good lesson to give before driving single.

TO THROW A HORSE.

To throw a horse, put on him a surcingle with crupper, with a 2-inch ring fastened in the top of the surcingle. The surcingle and crupper may be made with one piece of rope. Double a 15-foot rope at about one-third its length and slip a 2-inch iron ring over this

doubled portion. Tie a knot in the doubled rope to hold the ring. The loop should be put under the horse's tail for a crupper, and the ends of the rope form a surcingle. The surcingle should fit tight.

When the surcingle and crupper are adjusted take a 20 or 30 foot rope, pass one end through the ring in the backband of the surcingle along the side of the horse's neck, through the ring in the halter, back to the backband, and tie; tie up the front leg on the side on which you desire the horse to fall, the rope from the backband to the halter being on the opposite side. The noseband of the halter should be well down on the horse's nose and fit fairly tight.

Allow the horse to stand for a few minutes, and then with the pulley rope draw his head to one side; he will drop to the knee that

FIG. 9.—Arrangement of ropes to throw a horse.

is tied up and may be easily thrown over on his side. When he tries to get up pull his head to the backband.

Another method is to put straps with rings on the pasterns of the hind feet, tie a loop in the middle of a 40-foot rope, fit the loop on as a collar, running the ends through straps on pasterns, back and through rope collar and out to the side; tie up one front foot. As the horse is backed up his hind feet may be pulled forward with these ropes and he can then be easily thrown on his side.

HARNESS.

Harness should be kept clean and well oiled. It will then be less liable to cause sores on the horses and will last longer. Before the

harness is oiled it should be taken apart and thoroughly washed with soap and water. When nearly dry apply neatsfoot oil with a sponge or a woolen rag. Do not hang harness in heat or in the sun to dry. A tablespoonful of lampblack with 2 ounces of melted beeswax may be added to the oil for a black dressing. Fish oil may be used on harness, or prepared oils may be secured at harness shops. All parts of the harness should be strong.

Every horse should have its own collar, which should fit snugly to the neck from top to bottom. Most sore necks are caused by large collars or by draught being too low on the point of the shoulder. To fit a new or an old collar to a horse soak the collar over night in water, wipe it off in the morning, and fit it on the horse. Work

FIG. 10.—Throwing a horse.

moderately through the day. The collars should be examined every morning and the bearing surface kept clean and smooth. The horse's neck should be kept clean. A good plan in hot weather is to wash it every night with a weak solution of salt water. Keep the collar and hames buckled tight.

Before hitching to a wagon be sure that the neck yoke is safe and that the traces will not become unfastened.

IMPORTANCE OF A GOOD MOUTH.

When we say that a horse has a good mouth we mean that he readily obeys the signals conveyed to him by the reins and bit and that he will also "go up on the bit" in his work without pulling.

A horse is held steady and true in his gait and at all times is under better control when he is "up on the bit."

Always see to it that the bridle on the colt is properly adjusted, and never use a severe bit. The bit should be adjusted in the mouth tight enough so that the rings will not be pulled in, but loose enough so that the corners of the mouth will not be pulled or stretched up. The bit should rest on the bar, above the tushes.

Always train the colt to walk rapidly. There is no gait so valuable and useful in a horse as a rapid walk. It is not difficult to train the

FIG. 11.—Holding a horse down.

average colt to walk fast. From the very beginning keep him walking up to his limit, and he will get into the habit.

When a horse trots make him trot "up on the bit"; he will have a better head and neck carriage, will be less liable to stumble, and will give his attention to the driver.

A colt's mouth may be spoiled by severe bits, by a too tight adjustment of the reins of the bitting harness, by tight check reins, by unnecessary jerking and lugging on the lines, or by a poor driver.

Horses for racing, high-stepping carriage horses, and fine saddle horses require special schooling and training, and their development had better be intrusted to the regular trainers.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1915

UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 668 MAY 26, 1915

Contribution from the Bureau of Entomology, L. O. Howard, Chief.

THE SQUASH-VINE BORER.[1]

By F. H. CHITTENDEN,

In Charge of Truck Crop and Stored Product Insect Investigations.

GENERAL APPEARANCE AND METHOD OF WORK.

One of the most troublesome of the many enemies of squashes, pumpkins, and other cucurbits is the squash-vine borer. In many localities this species surpasses all other squash insects in point of injuriousness.

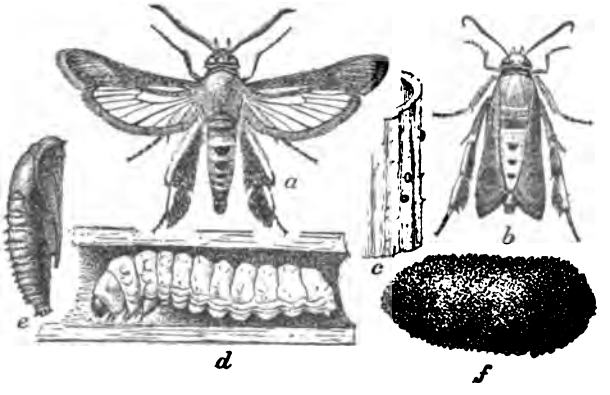

FIG. 1.—Squash-vine borer (*Melittia satyriniformis*): *a*, Male moth; *b*, female, with wings folded at rest; *c*, eggs shown on bit of squash stem; *d*, full-grown larva, *in situ* in vine; *e*, pupa; *f*, pupal cell. All one-third larger than natural size. (Author's illustration.)

Damage is due to the larvæ boring through the stems, causing them to rot at the affected points and become severed from the vine, or so injuring the vine as to cause the leaves to wilt and the plant to die. The presence of the borer feeding within the stem is not apparent at the commencement of the attack, but soon becomes manifest through the presence of the coarse yellowish excrement which it forces from its burrow in the stem and which accumulates on the ground beneath, as well as by the sudden wilting and dying down of the leaves. Wilting occurs soon after the larvæ have made

[1] *Melittia satyriniformis* Hbn.; order Lepidoptera, family Sesiidæ. In early publications this species was generally known as *Melittia cesto*, or *cucurbitæ*.

NOTE.—This bulletin is a revision of Circular No. 38 of the Bureau of Entomology, U. S. Department of Agriculture.

considerable growth within. From one to half a dozen or more larvæ inhabit a stem, and often upward of forty individuals have been taken from a single plant; indeed, one grower has stated that he once cut "142 larvæ from a single vine." The larvæ work with great rapidity and in a very short time are able to injure a plant so that no fruit will mature. Injury is most noticeable near the base of the stems, where in course of time the vine becomes severed from the roots and the whole vine dies.

The parent of this insect is a beautiful, medium-sized moth. The forewings are opaque, lustrous olive-brown in color, with metallic green reflections, and expand from less than an inch to nearly an inch and a half. The hindwings are transparent and veined as shown in the accompanying illustration of the male (fig. 1, *a*). The abdomen is conspicuously marked with orange or red, black, and bronze, and the hind legs are fringed with long hairs—red or orange on the outer surface and black inside. The natural position of the moth when at rest is shown by the figure of the female (*b*).

DISTRIBUTION.

As far as known, the squash-vine borer is a native of the Western Hemisphere, and widely distributed and injurious in the United States practically wherever squashes are cultivated. Available records and examination of material in the collection of the U. S. National Museum show that it has a range embracing territory from the New England States and Canada, in the north, to the Gulf States southward, and westward to the region beyond the Missouri River, which comprises the major portion of the Carolinian and Austroriparian areas of the Upper and Lower Austral life zones and a portion also of the Transition zone. Injury has been observed to be particularly severe in recent years on Long Island and in New Jersey, Delaware, Maryland, Virginia, and the District of Columbia, in the East, and in Kansas and Nebraska in the West. Other States in which injury has been noted include Maine, Massachusetts, Connecticut, Rhode Island, Georgia, Alabama, Mississippi, Louisiana, Iowa, and Michigan. It is evidently of tropical origin, and occurs in Mexico, where it is also widely distributed, and in Guatemala, Panama, Venezuela, Argentina, and the lower Amazon.

FOOD HABITS.

The vines of squash and pumpkin form the chief food supply of this insect, but occasionally it attacks also the gourd, muskmelon, and cucumber. It does not, however, in the writer's experience, infest melons and cucumbers when the other preferred crops are available. The larvæ bore through the stems from the roots to the base of and even through the leaf stalks, and young larvæ may be found even in

the larger veins, into which they bore when the eggs have been placed in such locations, and often attack the fruit. They also penetrate gourds so hard that it is difficult to cut into them with a sharp knife. Larvæ have been observed on the wild balsam apple,[1] which is probably a natural food plant.

Injury is greatest to Hubbard, marrow cymlings, and other late varieties of squash, and is apt to be more acutely felt in small gardens than where crops are grown for market. Even if the plant survives attack it may not bear fruit, and often the grower loses a large proportion of his crop year after year. Not infrequently entire crops are destroyed, and still more frequently every plant in a field is attacked freely.

NATURAL HISTORY.

This species is injurious only in the larval form. Although the larvæ are familiar objects to squash growers, the moths are not generally recognized as the parents of these pernicious borers.

The moths, unlike most others, fly only during the daytime and in the heat of the day. Toward twilight they become less active and may be seen sitting quietly on the leaves of their host plants. Both when in flight and when at rest the moths are singularly wasp-like in appearance.

TIME OF APPEARANCE OF THE MOTH.

Approximately it may be stated that the moth appears as soon as the vines are sufficiently advanced to serve for oviposition and the subsequent subsistence of the borer larvæ within their stems. Indications are that as far south as the District of Columbia the moths make their first appearance in the field some time in May, or, at least, early in June, as larvæ nearly matured have been found by the middle of July. In New Jersey, according to Dr. J. B. Smith, the moths are abroad at or soon after the beginning of June; on Long Island, from the middle to the last of June. In Massachusetts, according to Harris, they appear about the plants the second week in July. We thus have considerable variation in time of earliest appearance, dependent upon season and locality—a variation to be expected in a species of so wide a range.

THE EGG AND OVIPOSITION.

The eggs, which are oval and dull red in color, are laid upon all parts of a plant, from the roots to the buds and petioles, but chiefly along the stems, although in some varieties of squash, it is said, nearer the base of the stem than otherwise. Oviposition is very rapid, the moth flitting from hill to hill, leaving an egg in each. A single moth may lay as many as 212 eggs. The eggs hatch in from six to fifteen days after they are deposited, and the larvæ are said to attain full

[1] *Echinocystis lobata.*

growth four or more weeks later. This period will undoubtedly vary in different temperatures, according to the season of the year when oviposition takes place.

Eggs are shown a little larger than natural at *c* of figure 1, and much magnified at *a* and *b* of figure 2, *c* showing the sculpture.

THE LARVA.

The larva is a soft, whitish, grublike caterpillar of nearly cylindrical form, with a small dark head and a few very sparse hairs on each segment. Larvæ in the earlier stages of growth are illustrated by *d*, *e*, and *f* of figure 2. A full-grown larva is shown in profile within an open stem at figure 1, *d*, and the head and first two thoracic segments appear in figure 2 at *g*. Mature larvæ measure about an inch (25 mm.) in length. In the District of Columbia full-grown larvæ, as already observed, occur as early as July 16; in New Jersey, later in July, and are to be found upon the vines in different stages in October; at Washington, as late as the second week of November.

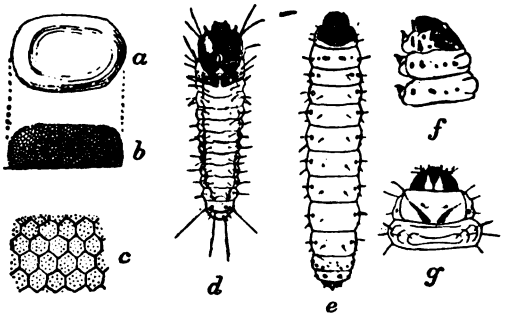

FIG. 2.—Squash-vine borer: *a*, Egg as seen from above; *b*, same from the side, showing sculpture; *c*, sculpture of egg greatly enlarged; *d*, newly hatched larva; *e*, half-grown larva; *f*, head of same from side; *g*, head of mature larva from above. *a*, *b*, and *c*, Much enlarged; *d*, *e*, *f*, and *g*, less enlarged. (Author's illustration.)

After attaining maturity the larvæ desert the stems and enter the earth, burying themselves to the depth of 1 or 2 inches, and form their cocoons, in which they transform to pupæ. The cocoon (fig. 1, *f*) is constructed of silk and coated externally with fine particles of earth, which adhere on account of some gummy secretion of the larva.

THE PUPA.

The pupa, or chrysalis (shown in profile at *e*, fig. 1), measures about ⅝ inch (16 mm.) in length. It is shining mahogany brown in color, and its head is ornamented in front just above and between the eyes with a hornlike process. By means of this the pupa cuts its way out of one end of its cocoon and by the aid of the abdominal hooklike spines forces itself to the surface of the earth before transforming to adult.

NUMBER OF GENERATIONS.

The question of the number of generations produced annually in localities of different temperatures which this insect inhabits has been solved by actual observation, the results serving to indicate that it is practically single-brooded on Long Island and northward; that there is a tendency to two broods in New Jersey, the moths in

exceptional cases completing their transformations late in August or September; that in the latitude of the District of Columbia the species is partially double-brooded, a larger portion of the moths, we may assume, developing as a second generation here than in New Jersey; and that in the Gulf States this species is undoubtedly fully two-brooded.

PREVENTIVE AND REMEDIAL MEASURES.

This borer is an exceptionally difficult insect to control, as ordinary insecticides are of no value after the insect has once entered the vines, and repellents are also practically useless. We are, therefore, dependent upon cultural methods for relief.

Knowing that the insect passes the winter in the fields which it has ravaged, it should be superfluous to caution growers against planting squashes in the same ground in successive years.

EARLY SQUASHES AS TRAPS.

Good results have been obtained by planting as a trap crop and as early as possible a few summer squashes, such as crooknecks and early cymlings, before and between rows of the main crop of late varieties. The summer squashes attract the insects in such numbers as to leave a smaller number to deal with upon the late or main crop. As soon as the early crop is gathered, or earlier if the ground is needed for the main crop, the vines are promptly raked up and burned to destroy all eggs and larvæ which they may harbor, and the same treatment is followed after gathering the late varieties. This method, according to the late Dr. J. B. Smith, has proved profitable where used in New Jersey and should produce good results farther north. Southward, where two well-defined broods appear, it might not be so productive of good, but it should be given a thorough test.

FALL HARROWING AND DEEP SPRING PLOWING.

Experiments conducted by Mr. F. A. Sirrine, of the New York Agricultural Experiment Station at Geneva, N. Y., show that this species can be greatly reduced by lightly harrowing the surface of infested squash fields in the fall so as to bring the cocoons of the vine borer to the surface, where they will be exposed to the elements, and then plowing in the spring to a uniform depth of at least 6 inches, so that the adults will not be able to issue.

OTHER CULTURAL METHODS.

When the vines have attained some length parts of them should be covered over with earth, so that secondary roots will be sent out to support the plants in case the main root is injured by the borer. Keeping the plants in good condition, free from other insects and from disease, and well nourished with the assistance of manure or

other fertilizer if necessary, will also aid the plants to withstand borer attack. When vines are so badly infested as to be incapable of bearing fruit they usually die at once, and they should then be promptly taken out and burned. The old vines should also be destroyed as soon as the crop is made.

CUTTING OUT THE BORERS.

The old-time remedy of cutting the borers out of the vines, although laborious, is useful, and about the only method open for employment after they have entered the vines. As several individuals often infest a single vine, it is best to cut longitudinally, so as not to sever the vine from the root stalk. If the wound made by cutting be afterwards covered with moist soil it will assist it to heal. The location of the borer in the vine can be readily detected by the accumulation of its yellow "frass" or excrement at the point where it is working, and which is kept open for the extrusion of this matter.

CAPTURING THE MOTHS.

This species may be held in partial subjection by keeping a sharp lookout for the parent moths, which are readily seen and not difficult of capture toward dusk or in the cool of the morning, when they are comparatively inactive. The female may then be easily caught, just as she alights on a vine for oviposition. Several persons, including the writer, can vouch for this statement.

SUMMARY.

If the grower would make certain of securing a good crop in localities where this and other enemies of the squash occur in their most destructive abundance, it will be necessary for protection against this borer to observe most of the following precautions, and, if possible, secure the cooperation of his neighbors in their observance:

(1) Not to plant in or near infested ground.

(2) To plant early varieties for the protection of late squashes.

(3) To harrow infested fields lightly in fall and plow deeply in spring, to prevent the moths from issuing.

(4) To encourage the growth of secondary roots by covering the stems with earth.

(5) To destroy dead vines and old plants as soon as the crop is made.

(6) To keep the plants in vigorous condition, free from other insects and disease.

(7) To cut out such borers as may succeed in entering the vines in spite of the employment of other remedial measures.

(8) The capture of the moths before egg deposition is advisable.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 669 MAY 25, 1915.

Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.

FIBER FLAX.

By FRANK C. MILES,
Scientific Assistant, Fiber-Plant Investigations.

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INTRODUCTION.

The purpose of this bulletin is to discuss the production of flax for fiber, yet it must not be understood that the seed is lost in growing fiber flax. In the course of the work conducted by the Office of Fiber Investigations it has been found that many persons believe it impossible to produce a high grade of flax fiber without sacrificing the seed. This belief, however, has repeatedly been shown to be a misconception. It is true that the variety of flax commonly grown in the Northwest for seed production will not, under present methods, yield a fiber suitable for spinning purposes. It is also true that the yield of seed from fiber flax usually is lower than that from flax grown primarily for seed, yet the quantity of seed produced is sufficient to constitute a valuable by-product.

NOTE.—This bulletin is intended for distribution throughout those Northern and Pacific Coast States where the conditions of climate are favorable for the growth of fiber flax.

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In all countries except Ireland where fiber flax is grown commercially, the general practice is to save the seed. In Belgium, where the highest quality of fiber is produced, seed from the best types of flax is used for sowing and the remainder is saved for feeding. In Russia the seed obtained is used for sowing, and in addition great quantities are exported for seed purposes. In Holland the seed is not only saved, but is highly prized for sowing. The characteristic climatic conditions in Ireland are such that the seed does not mature uniformly, and growers believe that the value of the seed which does mature is not sufficient to pay the cost of thrashing.

WORLD'S PRODUCTION OF FIBER FLAX.

According to the latest available statistics, more than four million acres of land are devoted each year to fiber flax, and it is estimated that this area produces about 800,000 tons of fiber. Russia is the great producer of medium-quality flax, and about four-fifths of the world's production is grown there. Austria-Hungary ranks second in respect to acreage, with France, Ireland, Belgium, and Holland following in the order named. Fiber flax is also grown to a certain extent in Germany, Italy, Roumania, and Japan. In recent years less than 2,000 acres have been devoted to fiber flax in the United States, while about 3,000,000 acres in this country are devoted to seed flax.

DISTRIBUTION OF FLAX SPINDLES.

Data obtained by the International Federation of Flax and Tow Spinners' Associations in regard to the location of the flax spindles of the world are shown in Table I.

TABLE I.—*Location of the flax-spinning factories of the world.*

Countries.	Number of spindles.	Countries.	Number of spindles.
United Kingdom	1,161,874	Italy	20,000
France	567,079	Sweden	18,158
Russia	367,207	United States	8,612
Belgium	315,404		
Austria-Hungary	296,833	Total	3,034,101
Germany	278,934		

Nearly one million spindles, or about one-third of the total number, are in Ireland. Irish linens are well known throughout this country, yet it is not generally known here that Ireland imports about three-fourths of the flax fiber used in the manufacture of these linens. Though France ranks second in number of spindles, the manufacturers there find it necessary to import about four-fifths of the fiber which is used.

IMPORTATIONS OF FLAX FIBER AND LINENS.

The spinning mills of the United States have been importing flax fiber for many years, and importations of materials manufactured from flax have been steadily increasing. The people of the United States are great users of linen, as evidenced by the fact that the value of the goods imported each year is more than $20,000,000. The quantities of fiber and of linens imported annually are shown in Tables II and III.

TABLE II.—*Average annual imports into the United States of flax fiber in 5-year periods from 1881 to 1910 and annual imports for the fiscal years 1911 to 1914, inclusive.*

Years.	Quantity.	Value.	Import price per ton.[1]	Years.	Quantity.	Value.	Import price per ton.[1]
	Tons.				*Tons.*		
1881–1885	5,655	$1,542,069	$272.69	1906–1910	9,909	$2,634,882	$265.91
1886–1890	6,866	1,911,888	278.46	1911	7,792	2,668,538	342.47
1891–1895	6,485	1,779,246	274.36	1912	10,900	3,778,501	346.65
1896–1900	7,198	1,569,759	218.08	1913	12,421	3,950,020	318.01
1901–1905	8,203	2,161,188	263.46	1914	9,885	2,870,274	290.37

[1] The import price of the fiber per ton is the average of all grades, including dressed line, scutched flax, tow of flax, etc. These were the declared values at the point of export and not the prices at which the fiber could be purchased in the United States.

TABLE III.—*Annual imports into the United States of linen goods for the fiscal years from 1904 to 1913, inclusive.*[1]

Year.	Value.	Year.	Value.
1904	$18,012,042	1909	$20,245,595
1905	17,930,367	1910	27,423,896
1906	21,382,886	1911	24,632,505
1907	23,783,323	1912	26,381,970
1908	19,693,823	1913	28,208,884

[1] The figures in this table, compiled from statistics published by the Department of Commerce, include woven linens, linen handkerchiefs, linen embroideries and laces, but not linen yarns, which will more than offset the value of cotton in some of the goods made partly of cotton yarns.

About one-third of the fiber imported by the United States comes from Russia and about one-fourth of it comes from Belgium. More than one-half of the linens exported from Ireland are sent to the United States, and the statistics show that fully three-fourths of our linen imports are received from that country.

CONDITIONS IN THE UNITED STATES FAVORABLE FOR FIBER-FLAX PRODUCTION.

During the past years a number of statements have been made to the effect that flax fiber of good quality could not be produced in this country. Doubtless some of these statements were occasioned by failures of attempts to obtain fiber suitable for spinning purposes from the thrashed straw of the flax commonly grown in the Northwest for seed or oil production. In this connection it should be understood

that flax grown for fiber is a variety distinct from that grown primarily for seed production. (See fig. 1.) Furthermore, it has been established that in order to produce fiber flax of good quality greater care is essential in the selection and especially in the preparation of the soil and in the selection and grading of seed than is commonly practiced in growing flax for oil.

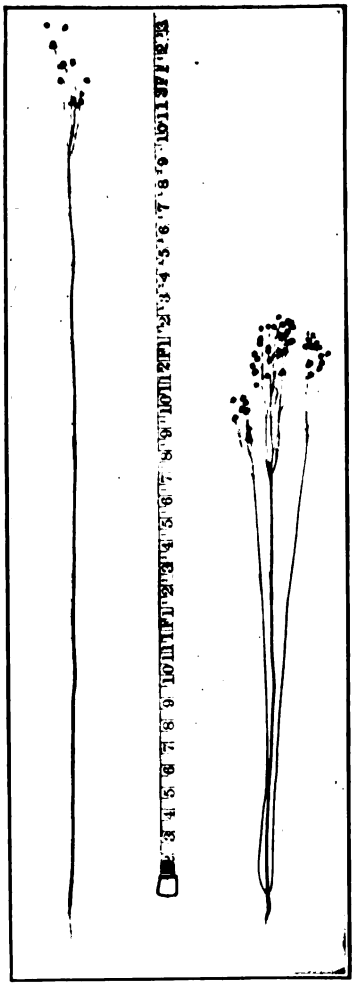

FIG. 1.—A fiber-flax plant (on the left), showing the characteristic tall stalk and few seed bolls and a plant of seed flax (on the right), with shorter stalks and many seed bolls.

A few years ago fiber flax of excellent quality was grown in the Puget Sound region. At the request of a representative from one of the Irish mills a quantity of this flax straw was sent to Ireland for retting and preparing according to their methods. The report of the firm conducting the work stated that the fiber obtained in the test compared very favorably with that produced in the famous flax region of Courtrai, Belgium.

Fiber flax of good quality has repeatedly been grown in Minnesota, Wisconsin, and Michigan on a scale sufficient to demonstrate that it can be successfully done. In eastern Michigan it is now being grown commercially to a limited extent.

These various demonstrations indicate rather clearly that the soil and climatic conditions in certain sections of the United States are favorable for growing fiber flax provided the proper cultural methods are employed. The areas in which climatic conditions are most favorable for growing fiber flax are shown on the accompanying map (fig. 2).

CLIMATIC RELATIONS.

Fiber flax can best be grown in regions where moderately cool, damp weather prevails during the summer. Under favorable soil conditions the plants respond to a humid atmosphere and a relatively low and uniform temperature during a long growing season by developing tall stalks with fiber of good quality. In localities where,

during the season of growth, the temperature frequently rises to high points and the soil becomes very dry, the crop matures earlier and the plants are much shorter.

Sufficient moisture is needed to enable the plants to continue, without interruption, their growth during the period of elongation of the stems. Under certain conditions the soils of some regions might be capable of retaining moisture sufficient to meet the requirements of the plants throughout this period, but in nearly all cases rainfall is needed during this time. It is desirable that there should be little or no rainfall during the ripening period and harvesting time.

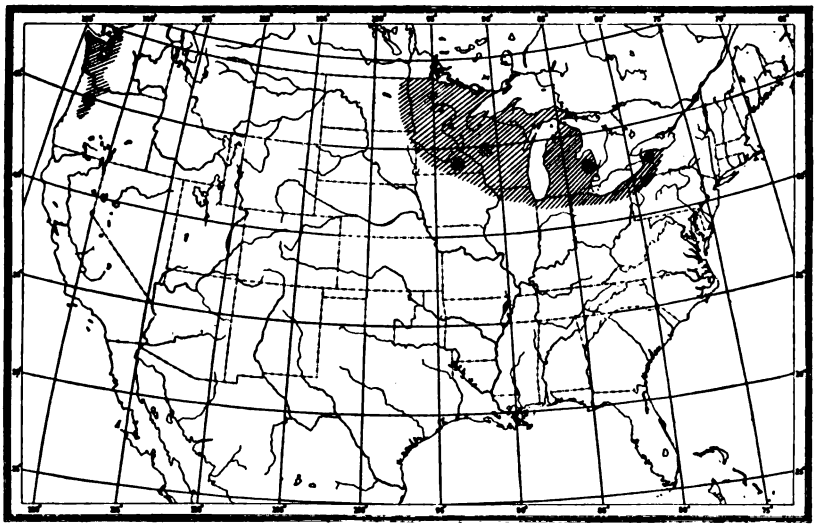

FIG. 2.—Map of the United States, showing by crossed lines the areas where fiber flax has been grown in recent years and by single lines areas having climatic conditions favorable for its production.

The weather records show that conditions of temperature and humidity of the principal flax-growing centers of Europe are very nearly the same as those which prevail in certain sections of New York, Michigan, Wisconsin, Minnesota, Oregon, and Washington. There are other localities in the United States where the climate is suitable for growing flax for fiber, but the States mentioned are cited because fiber flax of good quality has been grown there.

SOIL RELATIONS.

The soils on which fiber flax is to be planted should be of such a nature that good drainage is afforded, as the plants will not endure severe inundation. At the same time the soil should have good water-retaining capacity. A gently sloping field having a loam soil with a clay subsoil is suitable, provided it is in a good state of fertility and is free from weeds.

Fiber flax has been grown on muck soils, and also on light sandy soils, with varying success. When grown upon muck, the experience generally has been that the plants attained a good height, but the quality of the fiber was not equal to that of fiber produced on upland. When grown upon sandy soils, the difficulty is that the crop is too dependent upon frequent rainfall for the necessary moisture, since there is so little available water stored in such a soil.

The land selected for fiber flax should be of good fertility. In Ireland the Department of Agriculture and Technical Instruction has found that the addition of some available form of potash to the soil has given profitable results in a series of experiments extending through several years, and it is recommending this practice to the Irish growers. It would be difficult to recommend a practice of fertilization which would be applicable to all sections where fiber flax can be grown, as the solution of this problem is governed very largely by local conditions. Many flax growers apply barnyard manure to the soil at some period of the rotation. If this practice is followed, it is advisable that the manure be applied to a crop preceding flax, because if applied directly the flax is likely to be uneven, and quantities of weed seeds are nearly always introduced with stable or barnyard manure. Moreover, it is not advisable to use barnyard manure when flax straw has been used as bedding for the animals, since in this way the soil may become infected with flax diseases which live over in the old straw. If manure having flax straw or chaff in it is to be utilized for fertilizing land intended for flax, it should be thoroughly composted before being applied.

It has often been asserted that flax depletes the soil fertility to a greater extent than the other agricultural crops, and no doubt many of these assertions were based upon observation. If a farmer noted a diminished yield in the crop immediately following flax, he might conclude that the flax had required an extraordinary quantity of plant food. This conclusion, however, was based on apparent results, since the real cause of the diminished yields may not have been understood.

It has been found upon investigation that an average crop of flax removes less plant food from the soil than does a crop of corn or oats. Flax plants have delicate root systems which occupy only the upper few inches of the soil, while the plants of oats and corn have more vigorous root systems which may penetrate the subsoil. Hence, oats and corn may obtain from the subsoil a portion of the food materials essential for plant development, but flax plants necessarily must obtain practically their entire nourishment from the upper few inches of surface soil which the roots occupy. Undoubtedly, then, more of the available plant food in the upper 5 or 6 inches of soil is removed

by flax than by the deeper rooted crops. Therefore, in preparing flax stubble for the succeeding crop care should be taken to plow deep enough to bring up some of the subsoil in order to replenish the surface soil with available plant food.

PREPARATION OF THE SEED BED.

Too much emphasis can not be placed upon the necessity of a thorough preparation of the seed bed, for upon this more than upon any other cultural factor will depend the success or failure of fiber-flax production. It is indeed futile to attempt to produce a fine quality of fiber unless one is willing to expend the utmost effort in preparing the soil for seeding. Additional time and effort spent in putting the land in the best possible condition will be repaid (1) by a more uniform growth of plants, resulting in a more uniform quality of fiber, and (2) by greater ease in harvesting.

If a clover field or other sod is to be prepared for fiber flax, the field should be plowed in the fall. If flax follows a cultivated crop, spring plowing usually is satisfactory. Numerous dead furrows are to be avoided, as the flax which grows therein is short and difficult to harvest. A few days prior to seeding, the land should be double disked or cultivated with a spring-tooth harrow. In either case it is preferable to work the field diagonally. The peg-tooth harrow should be used as many times as may be necessary to render the soil very fine and to leave the surface smooth. A firm seed bed is very desirable, and in order to secure this it is often advisable to use a roller. The land is not ready for seeding until it has been reduced to a fine and compact condition.

SEED AND SEEDING.

Mention of the distinction between flax grown for fiber and that grown for seed or oil has already been made. The seed used in the United States for growing fiber flax is imported from the flax regions of Europe. Part of it is secured directly from Russia, though some growers prefer Russian seed which has been grown one or two years in Holland or Belgium. Heretofore the practice has been to grow the stock of seed thus obtained for not more than three or four generations and then to import a fresh stock.

The results thus far obtained in experiments conducted by the Office of Fiber-Plant Investigations seem to indicate that these frequent importations of seed are unnecessary provided proper attention is given to a seed plat. It is recommended that a portion of the field be set apart for producing seed. All weeds should be pulled from this plat, and the crop should not be harvested until the seed is fully matured. The grower can afford to sacrifice the quality of

the fiber from the seed plat in order to secure plump, well-matured seed for his general crop the next season.

The seed should be passed through a fanning mill or a seed grader of such a nature that all dirt, chaff, weed seeds, and light, immature seed will be eliminated. A homemade seed grader which has done satisfactory work is shown in figure 3. Only the heavy, well-matured seed should be selected for planting.

In order to insure against infecting the soil with disease organisms, which later might injure or destroy the growing plants, the seed intended for planting should be given formaldehyde treatment. This treatment consists of spreading the seed on a tight floor and spraying it with a solution made in the proportion of 1 pint of 40 per cent formaldehyde to 40 gallons of water. The best results can

FIG. 3.—A homemade seed grader. The octagonal frame is covered with sieves of increasing coarseness, first permitting the dust and fine seeds to fall through; second, the small flax seeds of marketable grade; and, third, the plump, large seeds for sowing, while the twigs and coarse material pass out at the end.

be accomplished by using a spraying outfit which throws a fine misty spray. Then, by turning the seed with some such implement as a hoe or a rake, the entire surface of the seeds can be covered with the formalin solution. About 2 quarts of the spray material will be sufficient for each bushel of flax seed. While drying, the seeds should be turned occasionally with a scoop shovel to prevent them from adhering to each other.

Fiber flax should be sown as early in the spring as is practicable after the danger of freezing weather is past. The experience of flax growers in eastern Michigan shows that the best quality of fiber is obtained from early-planted flax.

The seed should be sown broadcast. This can be accomplished with many of the modern seeders. Satisfactory work has also been

done with a fiddle seeder. In case the grower has a grain drill but no broadcasting seeder, he can sow the flax in a satisfactory manner by pulling the grain tubes from the drill shoes and tying each tube behind its shoe.

The experience of successful fiber-flax growers in this country has shown that seed should be sown at the rate of from 5 to 7 pecks per acre. Six pecks per acre on well-prepared soil has given the most uniform satisfaction. When smaller quantities of seed are planted, the tendency of the stalks is to branch and become coarse, with a poorer quality of fiber. When greater quantities of seed are planted, the stalks usually are very fine and uniform, but in case of rain accompanied by heavy wind near harvest time there is danger that the plants will go down, and, once lodged, it is nearly impossible for such thickly planted flax to regain an upright position.

After sowing, the seed should be covered about half an inch deep. This can be done with a very light peg-tooth harrow with the teeth set well back.

WEEDS AND DISEASES.

The presence of weeds in a field of flax grown for fiber is very detrimental, since it is necessary to remove them before preparing the fiber. When only a few weeds are present they should be pulled before the flax is harvested, but when the weeds are numerous it is not practicable to pull them, as is done in Belgium and Holland, and the best method of avoiding trouble with them is to plant fiber flax only on clean soil. There will be fewer weeds when flax follows clover or other sod.

The weeds which are most likely to be troublesome are Canada thistle, lamb's-quarters, pigeon grass, wild buckwheat, smartweed, morning-glory, pigweed, flax dodder, and some forms belonging to the mustard family.

The diseases which thus far have been most destructive to flax are those which are capable of living in the soil. After being introduced into the soil they may remain there several years, and then when flax is planted they may severely injure, and in some cases destroy, the crop. Flax wilt is one of these diseases which often does much damage.

The results of experiments conducted by Prof. H. L. Bolley, of the North Dakota Agricultural Experiment Station, indicate that flax growers may avoid introducing these disease organisms into the soil (1) by using thoroughly cleaned and graded seed which has been sprayed with formalin solution after the manner heretofore described and (2) by not applying barnyard manure which contains flax straw or chaff to land intended for flax. Moreover, since the organisms may live in the soil for several years, it is advisable not to plant flax on the same field more frequently than once in seven or eight years.

HARVESTING.

In order to secure the best quality of fiber, flax should be harvested before the seed is fully mature. Under average conditions the harvesting time is about 80 days after planting, though this period may vary from 70 to 100 days, according to season. Extremely hot and dry weather will shorten the growing period, while cool damp weather tends to lengthen it. When the lower parts of the stalks are turning yellowish and the lower leaves are beginning to drop, the flax should be harvested.

The usual method of harvesting fiber flax in European countries is by hand pulling, and this method has also been used in certain sec-

FIG. 4.—Pulling fiber flax.

tions of the United States where laborers could be secured at reasonable rates. (See fig. 4.) Under present conditions it appears impracticable to pull the flax in this country until a satisfactory pulling machine is made. Much work has been done along this line, and it seems probable that such a machine will be perfected.

When flax is cut there is a varying quantity of fiber left in the stubble, and when put in the shock the cut ends of the straw are in direct contact with the soil, and the fiber in the lower portion of the stalk may become badly discolored or otherwise injured. These disadvantages, however, are offset to a considerable extent by the diminished cost of harvesting. Moreover, when proper attention has been given to the preparation of the seed bed the surface of the

field will be smooth and even, so that the flax may be cut very close to the ground.

Self-rake reapers, mowing machines with tables back of the cutting bars, and grain binders have been used for cutting flax. When either of the first two machines is used, it is necessary to bind the bundles by hand; and in case the mowing machine with the table back of the cutting bar is used two men are required to operate it, one to drive the team and attend to the machine and one to rake the bundles off the table. It seems, then, that flax can be harvested with least expense by using a grain binder, though this method also has a serious disadvantage in the difficulty which is often experienced in

FIG. 5.—A field of fiber flax at harvest time. The bundles of pulled flax are set in small shocks to cure.

securing straight, uniform bundles, since flax tangles badly when being elevated and bound.

At the present time the grower receives from $2 to $3 more per ton for pulled flax than for cut flax, and there is, of course, a larger quantity per acre when the crop is pulled. Since, however, the cost of pulling ranges from $6 to $8 per acre, the additional profit gained by pulling usually is rather small; but in case a successful pulling machine becomes available undoubtedly the cost of pulling flax will be reduced and the farmer, as well as all those concerned in manufacturing the fiber, will profit from its use.

After the flax is harvested the bundles should be set up in small shocks to allow uniform drying. (See fig. 5.)

YIELD.

The yield of fiber flax is often expressed by giving the weight of harvested and cured straw before thrashing. This weight varies from 1 to 3½ tons per acre, though the average crop is from 1½ to 2½ tons. The quantity of seed which is borne on the straw varies from 4 to 15 bushels per acre, the average being from 6 to 10 bushels.

The yield of fiber will depend upon the care given to the preparation of the seed bed, the quality and quantity of seed sown per acre, the method of harvesting and of thrashing, and the manner of removing the fiber, as well as upon the available moisture and fertility of the soil. A yield of 770 pounds of clean retted fiber per acre has

FIG. 6.—Stacks of pulled fiber flax grown in eastern Michigan in 1914. Sometimes flax stacks are thatched, in order to better protect them until the fiber can be prepared.

been obtained in eastern Michigan, though the average yield there is from 400 to 550 pounds per acre.

MARKET.

The market has been a very important factor in limiting the production of fiber flax in this country. Under present conditions it is advisable for the grower to sell the flax straw with the seed on it to a flax dealer. The farmer is thus relieved of the retting and breaking processes.

The practice in eastern Michigan is for fiber flax to be grown under contract. The farmer purchases the seed from the flax dealer and furnishes the land and labor required to produce the crop. After harvest he delivers the cured flax straw to the dealer at the mill for a price usually agreed upon at planting time. The flax dealer stores the straw in warehouses or in stacks (fig. 6) until he can thrash it

and prepare the fiber. The prices paid to the farmer during the past three years have varied from $10 to $17 per ton, depending upon the condition of the straw and also upon whether the flax was cut or pulled.

PREPARATION OF THE FIBER.

The preparation of spinning fiber from flax straw is a process involving skilled labor and special machinery. These conditions render it impracticable for the individual flax grower to undertake it, though it might be practicable for a number of growers to do so by cooperation. An association of growers could secure the services of an experienced man who would superintend the various processes.

THRASHING.

The first operation after the flax is harvested and cured is to remove the seed. A method should be employed whereby the seed bolls may

FIG. 7.—Machine for thrashing fiber flax. The seed end of the bundle is passed two or three times between the wide pulleys, which revolve toward each other and are pressed together by springs.

be crushed or stripped off without breaking, doubling, or otherwise injuring the straw.

The common practice in this country has been to pass the head ends of the bundles between two wide pulleys held together by springs. (See fig. 7.) The mixture of seed and chaff thus obtained is passed between two rollers located just above the hopper of a fanning mill. The rollers crush any seed bolls in the mixture, and the fanning mill separates the seed from the dirt and chaff.

Another machine for thrashing fiber flax has been put in operation during the last year by one of the flax companies in eastern Michigan. (See fig. 8.) The flax passes sidewise across the feeding table between the belt and the large wheel and is thus held firmly, while a toothed cylinder, revolving just back of the large wheel, beats against the heads and removes the seed. The seed passes through the machine and is cleaned by means of sieves and fans, as in any thrashing machine. The straw passes along into a binder attachment and is again made into bundles. In this manner the straw is kept straight

FIG. 8.—A flax thrashing machine. The lower ends of the stalks may be seen passing between the belt and the large wheel, which holds them while the seed bolls are stripped off by a cylinder. The straw passes into the binder at the left and is made into bundles.

and in a form convenient to handle. It has been stated that this machine will thrash about 15 tons of flax a day.

RETTING.

The retting of flax consists of a treatment which will loosen the fiber from the woody portion of the stalk so that it may be readily removed. There are three principal methods of retting, viz, dew retting, water retting, and chemical retting. The process is of such a nature that an inexperienced person should not attempt it unless there is some one to superintend the work who does understand it. This statement holds for all three retting methods, yet it applies especially to water retting and to chemical retting.

Dew retting is the method employed in many of the flax-growing provinces of Russia and has been used in this country to a greater extent than the other methods. It consists of spreading the thrashed

straw in straight rows on a field, preferably a meadow, and allowing the action of rain, dew, or snow to remove the gummy materials which cause the fiber to adhere to the woody portion of the stalks. (See fig. 9.) This takes place in from two to eight weeks, depending upon the climatic conditions. The straw is sometimes turned once during the retting process.

The best flax fiber is obtained from the Courtrai region of Belgium, where flax is water retted in the River Lys. Flax is also water retted in Ireland and in certain provinces in Russia, but in these countries the retting is done in pools or reservoirs. The bundles of flax are usually placed upright in crates, or nets, and are immersed by placing weights on top of the whole. As fermentation progresses it is

FIG. 9.—Flax straw spread for dew retting. Most of the fiber flax grown in the United States has been dew retted.

generally necessary to add more weights in order to keep the straw under water. The retting process is usually completed in from 6 to 15 days, depending upon the condition of the water. The straw should be removed at just the proper time, as a few hours' delay often causes loss. The practice in Belgium and in some portions of Ireland is to watch constantly during the latter part of the retting period, in order to remove the straw from the water at the time when the retting process has progressed sufficiently, even though this be during the night. The straw is set on end to drain for about 24 hours and is then spread over a meadow for a few days, in order to become thoroughly dry. After drying, the straw is stored until time for breaking and scutching.

The chemical retting process has received considerable attention during the last few years. Various methods have been tried experimentally, but only a very few have been used on a scale sufficiently large to demonstrate whether they were practicable. A number of attempts have been made to ret chemically the thrashed straw of the seed flax grown in the Northwest and thus secure a fiber suitable for spinning, but none of these processes which have come under the observation of the Office of Fiber-Plant Investigations have been successful.

Promising results are being obtained, however, by one or two experimenters who have been using the tall, straight straw from fiber flax. Two points in favor of a chemical retting process are that

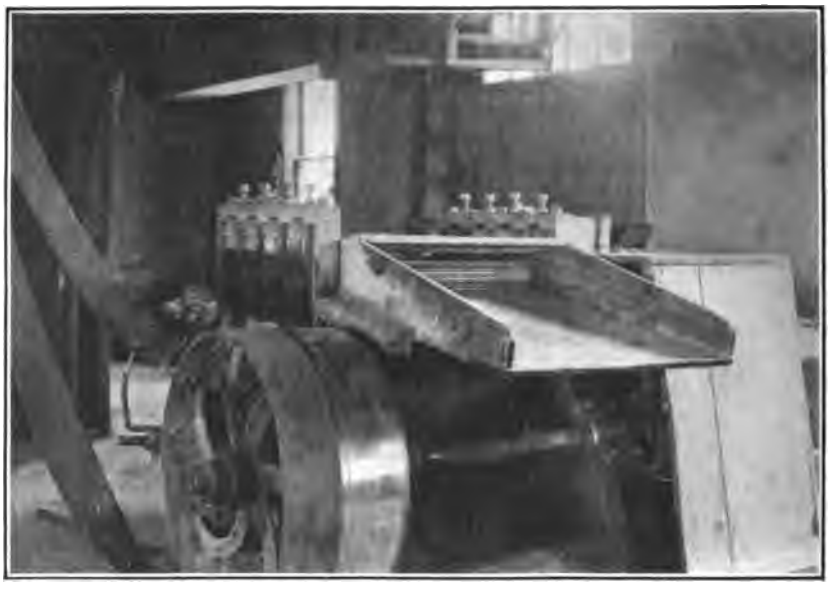

FIG. 10.—A flax brake. The woody portion of the retted flax straw is broken by passing the straw between the fluted iron rollers.

it is a rapid one and can be used the year round regardless of weather conditions. Spinners say that the fiber obtained in this manner is not suitable for general use, yet apparently it can be used successfully in certain lines of manufacture.

BREAKING, SCUTCHING, AND HACKLING.

One type of machine which is in general use for breaking flax straw is shown in figure 10. Very often the rollers of each succeeding pair have smaller corrugations and fit closer together than those of the one just preceding. The dry retted straw is fed endwise between the fluted rollers, and the woody portions of the stalks are broken into small pieces, while the fiber, being tough and elastic, remains unbroken.

The breaking process reduces the woody portion to short, small pieces, called shives, but removes only a small percentage of it. The shives are removed by scutching. The common method of doing this is by subjecting the broken straw, a handful at a time, to the beating action of a wheel with paddles radiating from its center.

After the fiber has been scutched it is reduced to a finely divided condition by a process known as hackling. This is done in some cases by machinery, though the best work is done by hand. The principle involved in either case is similar and consists of drawing the fiber over two or more series of sharp steel pins, the pins of each succeeding series being smaller and having sharper points. The fiber is thus divided to the degree of fineness desired by the spinner.

POSSIBILITY OF ESTABLISHING A FLAX-FIBER INDUSTRY IN THE UNITED STATES.

It has been demonstrated beyond all doubt that fiber flax of excellent quality can be grown in various sections of the United States, yet it can not be said that the industry has ever become established here. One reason for this is that much cooperation is necessary between the different branches of the industry, and up to the present time this cooperation has not existed. The farmer can grow the flax, but before doing so he should be assured of a market. On the other hand, the manufacturers should be assured of a sufficient supply of flax in order that they may establish their branch of the industry.

The individual farmer can grow fiber flax, but it is not practicable for him to carry on the processes of preparing the fiber. If the farmers wish to do this, they should agree upon some form of organization whereby they would be enabled to hire an experienced man to superintend the work of preparing the fiber. Unless there are a number of farmers willing to cooperate in some such manner, it is advisable that they grow flax under contract with a flax-fiber dealer. The dealer undoubtedly would be glad to offer suggestions regarding the various phases of flax culture and after harvest would purchase the flax straw from the farmer. The flax dealer would then prepare the fiber for the manufacturers, as he would be in touch with market conditions.

The price which the flax dealer can pay to the farmer is governed by the price which he in turn can secure from the spinner. The difficulty in the past has been that the spinners and manufacturers in this country have been willing to pay but little more than half as much for American-grown fiber as they have paid for imported fiber of equal grade. The manufacturers in turn may be contending to a certain extent with a prejudice which seems to exist in favor of

imported flax fiber and linen goods. As long as such a situation prevails, linens made from American flax can not sell in our stores for the price that is quoted on foreign linens of equal grade. If a salesman should offer at the same price two pieces of linen of equal quality, one manufactured in this country and the other imported, the customer would almost invariably purchase the imported goods. Hence, it seems apparent that only when the users of linen in this country are willing to buy American-made goods can our manufacturers compete with foreign houses whose goods have an established reputation. Since, however, about $3,000,000 worth of flax fiber is imported annually by our manufacturers for the purpose of making shoe thread, sewing thread, twines, and toweling, it seems that the popular prejudice against American linens has been extended even against American-grown fiber.

The production of flax fiber in Europe has been decreasing, and just at present the supply of European fiber is cut off. The present prices of this fiber are the highest on record. Even under very favorable conditions it will be several years before flax production in Europe will have regained its former proportions, and thus it seems that the present is a most opportune time for establishing a flax-fiber industry in the United States.

It must be remembered, however, that it is not advisable for the individual farmer to grow fiber flax commercially until he is willing to cooperate with either his neighboring farmers or a flax dealer. Only when there is hearty cooperation between the various branches of the industry from the grower to the manufacturer can there be hope of lasting success, but if this kind of cooperation should come into existence the popular prejudice against American linen goods could be overcome and a permanent flax-fiber industry of large proportions could be established.

SUMMARY.

The cultivation of flax for fiber and the cultivation of flax for seed or oil are two distinct industries. Fiber flax is a variety distinct from seed flax.

Fiber flax yields both spinning fiber and seed suitable for oil production.

The straw of seed flax grown in the Northwest does not yield a fiber suitable for spinning.

Russia has been producing about four-fifths of the world's supply of flax fiber.

About one-third of the flax spindles in the world are in Ireland.

The United States imports annually about $3,000,000 worth of flax fiber and more than $20,000,000 worth of linen goods.

The climatic and soil conditions in various sections of the United States are favorable for growing fiber flax. A relatively low temperature and sufficient moisture during the growing season are desirable. In general, a loam soil with a clay subsoil is to be recommended.

The preparation of the seed bed is one of the most important factors in the culture of fiber flax. Sod should be fall plowed. The seed bed should be rendered fine and compact before seeding.

The seed should be thoroughly cleaned and graded and should be treated with formaldehyde. It should be sown broadcast at the rate of about 6 pecks per acre and should be covered not more than half an inch deep.

Fiber flax should not be sown on soil infested with weeds, since the weeds would have to be removed at some time before the fiber could be spun.

Flax diseases live in the soil a number of years; consequently, it is not advisable that flax be planted on the same field more frequently than once in seven or eight years.

Pulled flax is of greater value for fiber than cut flax. The practice of pulling is recommended if practicable means of doing it can be perfected.

An average yield of fiber flax in this country is about 2 tons of unthrashed straw per acre, from which 6 to 10 bushels of seed and 400 to 550 pounds of clean retted fiber may be obtained.

The preparation of flax fiber requires technical knowledge and should be undertaken only by those who are experienced in that line of work.

In the past, the market has been an important factor in discouraging the production of fiber flax in the United States. It has been repeatedly demonstrated, however, that excellent flax fiber can be produced here, and it is hoped that the prejudice which has existed against American fiber and linen goods can be overcome by earnest cooperation among all those engaged in the industry.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 670 JUNE 3, 1915.

Contribution from the Bureau of Biological Survey, Henry W. Henshaw, Chief.

FIELD MICE AS FARM AND ORCHARD PESTS.

By D. E. LANTZ, *Assistant Biologist.*

INTRODUCTION.

The ravages of short-tailed field mice in many parts of the United States result in serious losses to farmers, orchardists, and those concerned with the conservation of our forests, and the problem of controlling the animals is one of considerable importance.

Short-tailed field mice are commonly known as meadow mice, pine mice, and voles; locally as bear mice, buck-tailed mice, or black mice. The term includes a large number of closely related species widely distributed in the Northern Hemisphere. Over 50 species and races occur within the United States and nearly 40 other forms have been described from North America. Old World forms are fully as numerous. For the purposes of this paper no attempt at classification is required, but two general groups will be considered under the names meadow mice and pine mice. These two groups have well-marked differences in habits, and both are serious pests wherever they inhabit regions of cultivated crops. Under the term "meadow mice" [1] are included the many species of voles that live chiefly in surface runways and build both subterranean and surface nests. Under the term "pine mice" [2] are included a few forms that, like moles, live almost wholly in underground burrows. Pine mice may readily be distinguished from meadow mice by their shorter and smoother fur, their red-brown color, and their molelike habits. (See fig. 1.)

MEADOW MICE.

Meadow mice inhabit practically the whole of the Northern Hemisphere—America, north of the Tropics; all of Europe, except Ireland;

[1] Genus *Microtus.* [2] Genus *Pitymys.*

NOTE.—This bulletin describes the habits, geographic distribution, and methods of destroying meadow mice and pine mice, and discusses the value of protecting their natural enemies among mammals, birds, and reptiles. It is for general distribution.

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and Asia, except the southern part. In North America there are few wide areas except arid deserts free from meadow mice, and in most of the United States they have at times been numerous and harmful. The animals are very prolific, breeding several times a season and producing litters of from 6 to 10. Under favoring circumstances, not

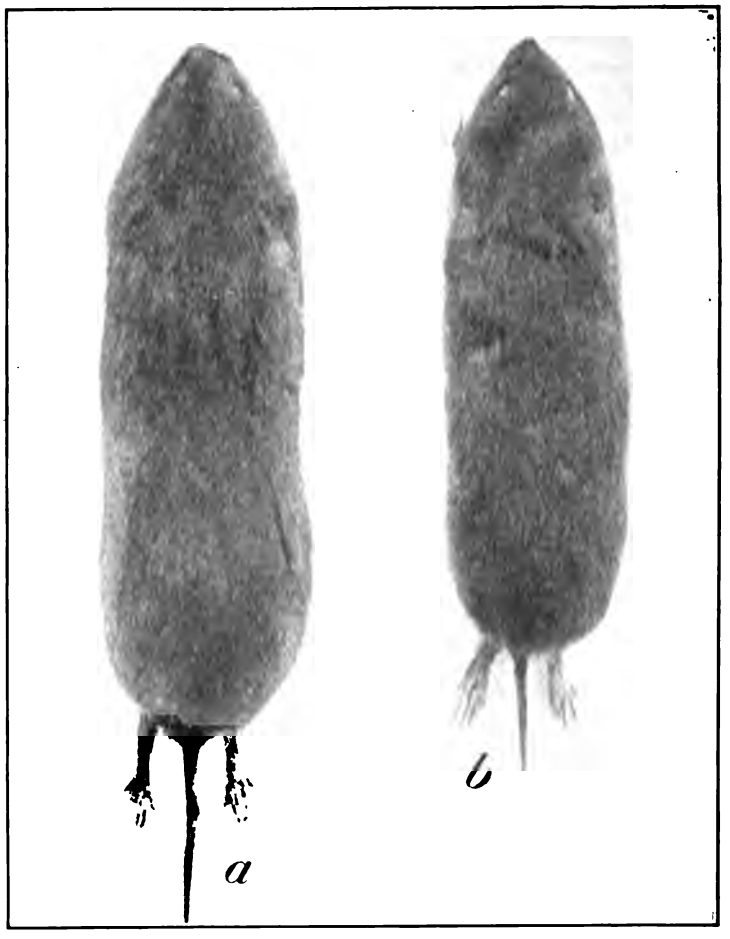

FIG. 1.—Field mice: *a*, Meadow mouse; *b*, pine mouse.

well understood, they sometimes produce abnormally and become a menace to all growing crops. Plagues of meadow mice have often been mentioned in the history of the Old World, and even within the United States many instances are recorded of their extraordinary abundance with accompanying destruction of vegetation.

The runs of meadow mice are mainly on the surface of the ground under grass, leaves, weeds, brush, boards, snow, or other sheltering litter. They are hollowed out by the animals' claws, and worn hard and smooth by being frequently traversed. They are extensive,

much branched, and may readily be found by parting the grass or removing the litter. The runs lead to shallow burrows where large nests of dead grass furnish winter retreats for the mice. Summer nests are large balls of the same material hidden in the grass and often elevated on small hummocks in the meadows and marshes where the animals abound. The young are brought forth in either underground or surface nests.

Meadow mice are injurious to most crops. They destroy grass in meadows and pastures; cut down grain, clover, and alfalfa; eat grain

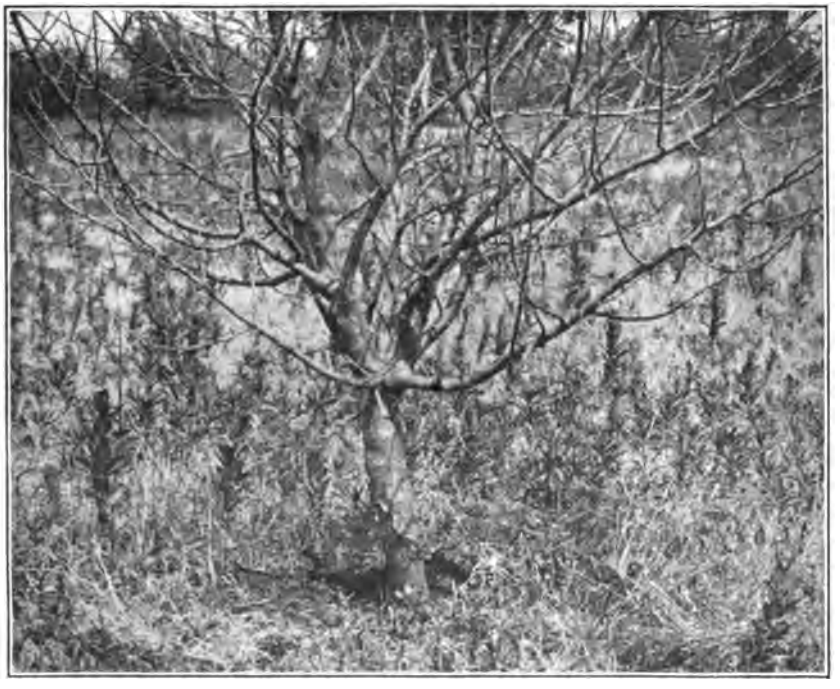

FIG. 2.—Apple tree killed by meadow mice.

left standing in shocks; injure seeds, bulbs, flowers, and garden vegetables; and are especially harmful to trees and shrubbery. The extent of their depredations is usually in proportion to their numbers. Thus, in the lower Humboldt Valley, Nevada, during two winters (1906–8) these mice were abnormally abundant, and totally ruined the alfalfa, destroying both stems and roots on about 18,000 acres and entailing a loss estimated at fully $250,000.

When present even in ordinary numbers meadow mice cause serious injury to orchards and nurseries. Their attacks on trees are often made in winter under cover of snow, but they may occur at any season under shelter of growing vegetation or dry litter. The animals have been known almost totally to destroy large nurseries of young

apple trees. It was stated that during the winter of 1901–2 nurserymen near Rochester, N. Y., sustained losses from these mice amounting to fully $100,000.

Older orchard trees sometimes are killed by meadow mice. In Kansas in 1903 the writer saw hundreds of apple trees, 8 to 10 years planted, and 4 to 6 inches in diameter, completely girdled by these pests. (Fig. 2.) The list of cultivated trees and shrubs injured by these animals includes nearly all those grown by the horticulturist. The Biological Survey has received complaints of the destruction of apple, pear, peach, plum, quince, cherry, and crab-apple trees, of blackberry, raspberry, rose, currant, and barberry bushes, and of grape vines; also of the injury of sugar maple, black locust, Osage orange, sassafras, pine, alder, white ash, mountain ash, oak, cottonwood, willow, wild cherry, and other forest trees.

FIG. 3.—Root and trunk of apple tree from Laurel, Md., gnawed by pine mice.

In the Arnold Arboretum, near Boston, Mass., during the winter of 1903–4, meadow mice destroyed thousands of trees and shrubs, including apple, juniper, blueberry, sumac, maple, barberry, buckthorn, dwarf cherry, snowball, bush honeysuckle, dogwood, beech, and larch. Plants in nursery beds and acorns and cuttings in boxes were especial objects of attack.

The injury to trees and shrubs consists in the destruction of the bark just at the surface of the ground and in some instances for several inches above or below. When the girdling is complete and the cambium entirely eaten through, the action of sun and wind soon completes the destruction of the tree. If the injury is not too extensive prompt covering of the wounds will usually save the tree. In any case of girdling heaping up fresh soil about the trunk so as to cover the wounds and prevent evaporation is recommended as the simplest remedy. To save large and valuable trees bridge grafting may be employed.

PINE MICE.

Pine mice occur over the greater part of eastern United States from the Hudson River Valley to eastern Kansas and Nebraska and from the Great Lakes to the Gulf of Mexico. Inhabitants chiefly of for-

ested regions, they are unknown on the open plains. Ordinarily they live in the woods, but are partial also to old pastures or lands not frequently cultivated. From woods, hedges, and fence rows they spread into gardens, lawns, and cultivated fields through their own underground tunnels or those of the garden mole. The tunnels made by pine mice can be distinguished from those made by moles only by their smaller diameter and the frequent holes that open to the surface.

FIG. 4.—Pine tree killed by pine mice.

While the mole feeds almost wholly upon insects and earthworms, and seldom eats vegetable substances, pine mice are true rodents and live upon seeds, roots, and leaves. Their harmful activities include the destruction of potatoes, sweet potatoes, ginseng roots, bulbs in lawns, shrubbery, and trees. They destroy many fruit trees in upland orchards and nurseries (fig. 3). The mischief they do is not usually discovered until later, when harvest reveals the rifled potato hills or when leaves of plants or trees suddenly wither. In many instances the injury is wrongly attributed to moles whose tunnels invade the place or extend from hill to hill of potatoes. The mole is seeking earthworms or white grubs that feed upon the tubers, but mice that follow in the runs eat the potatoes themselves.

Pine mice feed to some extent outside their burrows, reaching the surface through the small openings made at frequent intervals in the roofs of the tunnels. In their forays they rarely go more than a few feet from these holes. Most of their food is carried under ground, where much is stored for future consumption. While they differ

little from meadow mice in general food habits, their surroundings afford them a larger proportion of mast. They are less prolific than meadow mice, but this is more than made up for in the fact that in their underground life they are less exposed to their enemies among

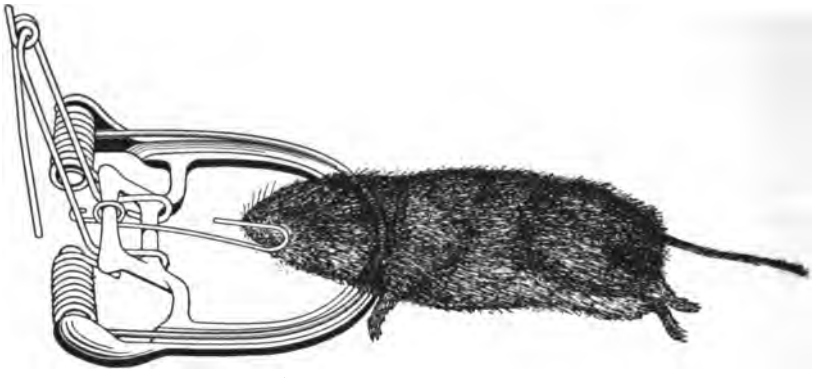

FIG. 5.—Field mouse caught in baited guillotine trap.

birds and mammals. Like meadow mice, they sometimes become abnormally abundant.

In the eastern part of the United States pine mice do more damage to orchards than do meadow mice, partly because their work is undiscovered until trees begin to die. The runs of meadow mice under grass or leaves are easily found and the injury they do to trees is

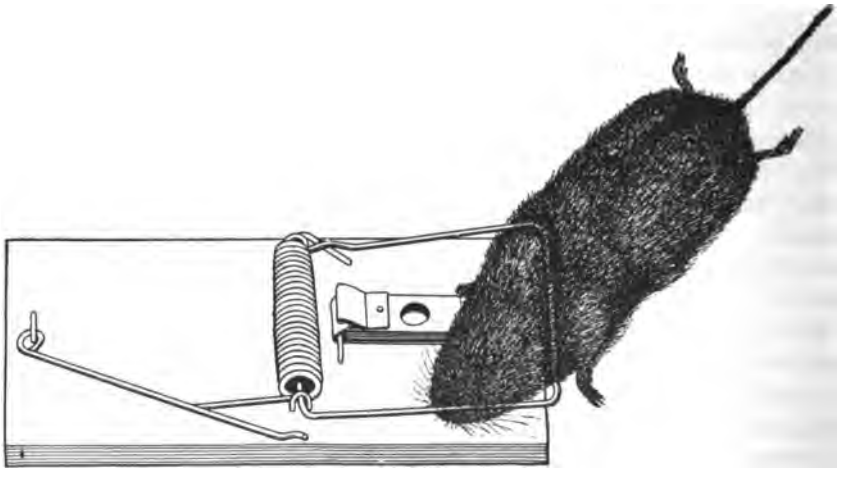

FIG. 6.—Field mouse caught in unbaited guillotine trap.

always visible. On the other hand, depredations by pine mice can be found only after digging about the tree and exposing the trunk below the surface. The roots of small trees are often entirely eaten off by pine mice, and pine trees as well as deciduous forest trees, when young, are frequently killed by these animals (fig. 4).

DESTROYING FIELD MICE.

Methods of destroying field mice or holding them in check by trapping and poisoning are equally applicable to meadow mice and pine mice.

TRAPPING.

If mice are present in small numbers, as is often the case in lawns, gardens, or seed beds, they may readily be caught in strong mouse traps of the guillotine type (figs. 5 and 6). These should be baited with oatmeal or other grain, or may be set in the mouse runs without bait.

Trapping has special advantages for small areas where a limited number of mice are present, but it is also adapted to large areas whenever it is undesirable to lay out poison. It is then necessary to use many traps and continue their use for several weeks. If mice are moderately abundant, from 12 to 20 traps per acre may be used to advantage. These should soon make decided inroads on the numbers of mice in an orchard if not practically to exterminate them. For pine mice the tunnels should be excavated sufficiently to admit the trap on a level with the bottom. A light garden trowel may be used for the necessary digging.

POISONING.

On large areas where mice are abundant, poisoning is the quickest means of destroying them, and even on small areas it has decided advantages over trapping.

The following formula is recommended:

Dry grain formula.—Mix thoroughly 1 ounce powdered strychnine (alkaloid), 1 ounce powdered bicarbonate of soda, and ½ ounce (or less) of saccharine. Put the mixture in a tin pepper box and sift it gradually over 50 pounds of crushed wheat or 40 pounds of crushed oats in a metal tub, mixing the grain constantly so that the poison will be evenly distributed.

Dry mixing, as above described, has the advantage that the grain may be kept any length of time without fermentation. If it is desired to moisten the grain to facilitate thorough mixing, it would be well to use a thin starch paste (as described below, but without strychnine) before applying the poison. The starch soon hardens and fermentation is not likely to follow.

If crushed oats or wheat can not be obtained, whole oats may be used, but they should be of good quality. As mice hull the oats before eating them, it is desirable to have the poison penetrate the kernels. A very thin starch paste is recommended as a medium for applying poison to the grain. Prepare as follows:

Wet grain formula.—Dissolve 1 ounce of strychnia sulphate in 2 quarts of boiling water. Dissolve 2 tablespoonfuls of laundry starch

in ½ pint of cold water. Add the starch to the strychnine solution and boil for a few minutes until the starch is clear. A little saccharine may be added if desired, but it is not essential. Pour the hot starch over 1 bushel of oats in a metal tub and stir thoroughly. Let the grain stand overnight to absorb the poison.

The poisoned grain prepared by either of the above formulas is to be distributed over the infested area, not more than a teaspoonful at a place, care being taken to put it in mouse runs and at the entrances of burrows. To avoid destroying birds it should whenever possible be placed under such shelters as piles of weeds, straw, brush, or other litter, or under boards. Small drain tiles, 1½ inches in diameter, have sometimes been used to advantage to hold poisoned grain, but old tin cans with the edges bent nearly together will serve the same purpose.

Chopped alfalfa hay poisoned with strychnine was successfully used to destroy meadow mice in Nevada during the serious outbreak of the animals in 1907–8. One ounce of strychnia sulphate dissolved in 2 gallons of hot water was found sufficient to poison 30 pounds of chopped alfalfa previously moistened with water. This bait, distributed in small quantities at a place, was very effective against the mice, and birds were not endangered in its distribution.

For poisoning mice in small areas, as lawns, gardens, seed beds, vegetable pits, and the like, a convenient bait is ordinary rolled oats. This may be prepared as follows: Dissolve $\frac{1}{16}$ ounce of strychnine in 1 pint of boiling water and pour it over as much oatmeal (about 2 pounds) as it will wet. Mix until all the grain is moistened. Put it out, a teaspoonful at a place, under shelter of weed and brush piles or wide boards.

The above poisons are adapted to killing pine mice, but sweet potatoes cut into small pieces have proved even more effective. They keep well in contact with soil except when there is danger of freezing, and are readily eaten by the mice. The baits should be prepared as follows:

Potato formula.—Cut sweet potatoes into pieces about as large as good-sized grapes. Place them in a metal pan or tub and wet them with water. Drain off the water and with a tin pepper box slowly sift over them powdered strychnine (alkaloid preferred), stirring constantly so that the poison is evenly distributed. An ounce of strychnine should poison a bushel of the cut bait.

The bait, whether of grain or pieces of potato, may be dropped into the pine-mouse tunnels through the natural openings or through holes made with a piece of broom handle or other stick. Bird life will not be endangered by these baits.

CULTIVATING THE LAND.

Thorough cultivation of fields and the elimination of fence rows between them is the most effective protection against field mice.

Cultivation destroys weeds and all the annual growths that serve as shelter for the animals. This applies equally well to orchards and nurseries. Clean tillage and the removal from adjoining areas of the weeds and grass that provide hiding places for mice will always secure immunity to trees from attacks of the animals.

PROTECTING NATURAL ENEMIES OF MICE.

Field mice are the prey of many species of mammals, birds, and reptiles. Unfortunately, the relation that exists between the numbers of rodents and the numbers of their enemies is not generally appreciated; otherwise the public would exercise more discrimination in its warfare against carnivorous animals. It is the persistent destruction of these, the beneficial and harmful alike, that has brought about the present condition of growing scarcity of predacious mammals and birds and corresponding increase of rodent pests of the farm, especially rats and mice. The relation between effect and cause is obvious.

Among the mammalian enemies of meadow and pine mice are coyotes, wildcats, foxes, badgers, raccoons, opossums, skunks, weasels, shrews, and the domestic cat and dog. Among birds, their enemies include nearly all the hawks and owls, storks, ibises, herons, cranes, gulls, shrikes, cuckoos, and crows. Among their reptilian foes are black snakes and bull snakes. Not all these destroyers of mice are more beneficial than harmful, but the majority are, and warfare against them should be limited to the minority that are more noxious than useful.

OWLS AND FIELD MICE.

Owls as destroyers of mice are deserving of special mention. Not one of our American owls, unless it be the great horned owl, is to be classed as noxious. Especially beneficial are the short-eared, long-eared, screech, and barn owls. All these prey largely upon field mice, and seldom harm birds. Unfortunately, the short-eared and barn owls, which are the more useful species, are not plentiful in the sections most seriously infested by field mice.

The short-eared owl, while widely distributed, is not abundant, except locally, within the United States, but wherever field mice become excessively numerous these owls usually assemble in considerable numbers to prey upon them. Examinations of stomachs of these owls show that fully three-fourths of their food consists of short-tailed field mice.

The barn owl is rather common in the southern half of the United States and breeds as far north as the forty-first parallel of latitude. That mice form the chief diet of this bird has been demonstrated by Dr. A. K. Fisher, of the Biological Survey, through examination of stomachs of many barn owls and also of large numbers of pellets (castings from their stomachs) found under their roosts. In 1,247

barn-owl pellets collected in the towers of the Smithsonian Building in Washington, D. C., he found 1,991 skulls of short-tailed field mice, 656 of the house mouse, 210 of the common rat, and 147 of other small rodents and shrews. Very few remains of birds were found. Figure 7 illustrates the contents of some of these pellets.

FIG. 7.—Field-mouse skulls taken from pellets found under owl roost in Smithsonian tower, Washington, D. C.

In 360 pellets of the long-eared owl Dr. Fisher found skulls of 374 small mammals, of which 349 were meadow mice. Stomach examinations give similar testimony to the usefulness of this bird.

The common screech owl, in addition to feeding mainly upon mice, destroys also a good many English sparrows. Its habit of staying in orchards and close to farm buildings makes it especially useful to the farmer in keeping his premises free from both house and field mice.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 671 MAY 26, 1915

Contribution from the Bureau of Entomology, L. O. Howard, Chief.

HARVEST MITES, OR "CHIGGERS."

By F. H. CHITTENDEN,

In Charge of Truck Crop and Stored Product Insect Investigations.

INTRODUCTION.

Residents of the South and of the more southern portions of many of the Central States, and especially visitors to these sections, are often subject to great annoyance due to the attacks of minute creatures popularly known as "chiggers" [1] and "red bugs," and incorrectly as ticks. These creatures occur in blackberry bushes, shrubbery, grass, and weeds, and persons walking or sitting down in such localities are liable to attack. "Chiggers" usually enter the skin near the shoe tops or at points below the knees, but sometimes they are jarred from bushes or small trees on to the neck and other exposed portions. Their habit of burrowing under the skin is not normal and brings about their death. Nevertheless the inflammation thus caused may become very painful, and where many of the creatures have attacked a person this may frequently lead to fever or other disagreeable consequences. The desire to scratch the affected spots is very strong, and scratching with the fingernails may easily abrade the skin and might communicate infec-

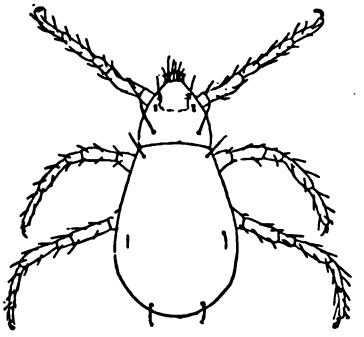

FIG. 1.—*Trombidium:* sp.: Larva, highly magnified. (From Banks.)

[1] The name "chigger" or "jigger" is evidently a corruption of chigoe, the pernicious sand flea (*Sarcopsylla penetrans* L.) of tropical America, a true flea, which crawls under the toe nails of man, producing painful sores which may result seriously if neglected.

NOTE.—This bulletin, which is a reprint, with revision, of Circular No. 77 of the Bureau of Entomology, U. S. Department of Agriculture, treats of the harvest mite and means for the protection and relief of human beings subject to its attack, together with methods of eradication. It will be of interest wherever this pest is troublesome.

tion from the nails or other outside sources. Children, and especially those who begin to go barefoot in grassy places in June to September, are great sufferers from this minute enemy.

WHAT "CHIGGERS" ARE.

These pests are the larval or six-legged forms of harvest mites of the genus Trombidium, the adults of which have eight legs. For present purposes we may consider the harvest mites as a class. In figures 1 and 2 illustrations of some common forms are furnished. The larval harvest mites are of microscopic size, blood red, and shaped somewhat like a common tick, being nearly as broad in front as behind. They belong to the order Acarina and are not true insects (Hexapoda), but are members of a distinct class (Arachnida) along with ticks, spiders, and the like. The parent mites are predaceous on true insects. As early as 1834 Mr. A. L. Dugès[1] made observations on these mites, which, as previously stated, have six legs in the immature or parasitic stage, while the adults have eight. The adults are of different shades of red and are quite visible. Many persons are familiar with the appearance of the young of certain species, as they occur on the under surface of the bodies of grasshoppers and harvest spiders or "daddy-long-legs" (Phalangiidæ) and under the wings of the house fly. Just what species of harvest mites are troublesome to man in the United States is not known, but one of them, perhaps the commonest, is referred to in literature as "*Leptus*" *irritans* Riley.[2]

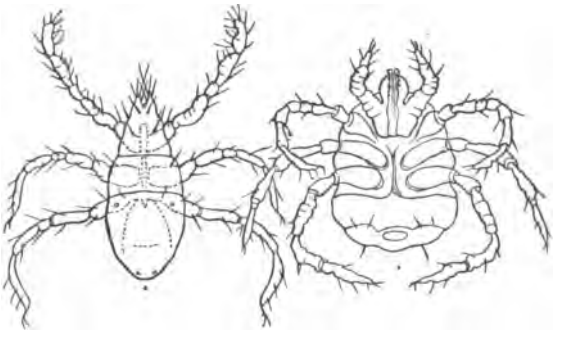

FIG. 2.—*Leptus americanus* at left; *Leptus irritans* at right. Highly magnified, dots under anal extremity indicating natural size. (After Riley.)

SYMPTOMS AND MANNER OF ATTACK.

Soon after the harvest mite burrows under the human skin a small red spot appears (evidently the mite itself gorged with human blood),

[1] Dugès, Ant. Recherches sur l'ordre des Acariens en general et la famille des Trombidiés en particulier. *In* Ann. Sci. Nat. Zool., t. 1, ser. 2, art. 1, p. 36, 1834; see also Megnin, P., Memoire sur les Metamorposes des Acariens en general et en particulier sur celles des Trombidions. L. c., t. 4, sér. 6, art. 5, p. 1–20. 1876; and Murray, Andrew, Economic Entomology, Aptera, p. 129–133, London, 1877.

[2] Riley, C. V. Poisonous insects, p. 745, fig. 2980, New York. 1887. (Extracted from Reference Handbook of the Medical Sciences, v. 5.)

Leptus is a genus founded on the larval Trombidium. Those who may desire further information in regard to the structure of the adult may consult Banks, Nathan: "A treatise on the Acarina, or mites." (*In* Proc. U. S. Nat. Mus., v. 28, p. 30, 31, 1904.)

after which the surrounding surface becomes congested, the affected area spreading until it is from less than a fourth to a half or three-fourths of an inch in diameter. This congestion may manifest itself within less than an hour after exposure or may not be apparent for 12 hours or so, the fever being at its height usually on the second day. The symptoms are apt to be first noticed when the sufferer has removed his clothing at night, or upon awakening from sleep. It sometimes happens that there is little irritation until some time after exposure, but with most persons susceptible to the poisonous effects of these mites irritation is first experienced on the second day. The feverish appearance of the afflicted skin area varies according to the susceptibility of the person attacked. Children dwelling or sojourning in mite-infested localities suffer greatly from these pests, experiencing more severe annoyance than adults, and young women as a rule suffer more than older persons. People with thin, delicate skin and florid complexion are most afflicted by the mites, and with them the congested red spots are proportionately larger and more inflamed and irritating.

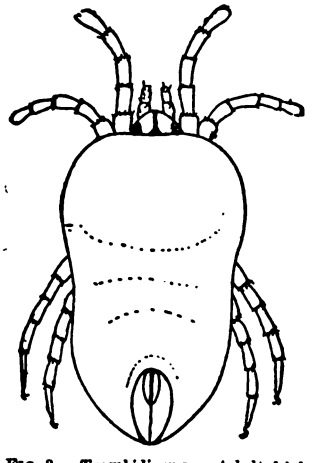

FIG. 3.—*Trombidium* sp.: Adult, highly magnified. (From Banks.)

Many persons, however, as, for example, permanent residents of infested regions, and particularly farm laborers, seem to be practically proof against the toxic effects of harvest mites and go with impunity into places overrun with them. This immunity to poisoning is obviously due to two causes: (1) To outdoor work which toughens the person's skin, especially such portions of the arms and legs as are much exposed to the sun and weather; and (2) to inoculations, due to frequent infection.

The inflamed spots due to the presence of the mites under the human cuticle are often diagnosed as hives, nettle rash, urticaria, or the "wheals," and resemble closely those produced on many persons by the "bites" of fleas and some mosquitoes, but on the second or third day each of the mite-infested areas is usually found surmounted at the middle by a minute vesicle or water blister. This is obviously the most important characteristic of harvest-mite attack. After the subsiding of the inflammation and itching, which takes place in a few days, a small scale or scab frequently forms, leaving on some persons a scar which does not wholly disappear in extreme cases for weeks. The mites naturally attack first those portions of the body which are most exposed—those nearest the ground. They crawl into the

stockings and penetrate the skin about the ankles, frequently below the shoe tops, and are usually found most numerous below the knee. According to the late Dr. John Hamilton, a physician as well as entomologist, the harvest mites enter the larger sweat tubes or pores of the skin, and as these tubes are very tortuous, the progress of the mites is necessarily slow, from 18 to 36 hours being required for them to reach the end. When the lesions caused by these mites are unusually numerous, the sufferer becomes feverish, and sleep is much disturbed. Sometimes the afflicted one becomes frantic and lacerates his flesh by too vigorous and frequent scratching. Erysipelas is known to follow severe attacks, and death resulting from blood poisoning is recorded. These more serious results of infestation are, however, exceptional and, as with the fatalities which in rare cases follow the ordinarily merely painful or annoying "bites" of many insects, undoubtedly point to an impurity of the blood.

HABITAT.

Harvest mites are most abundant in damp locations, along the borders of streams and other bodies of water, and on the edges of forest and woodland. They occur also on trees and shrubbery, evidently infesting the lower surface of the leaves, from which they drop off when these are rudely shaken, and find lodgment on the neck or other exposed parts of the body. Riley describes "*Leptus americanus*" as affecting chiefly the scalp and armpits. In places infested by harvest mites it is a matter of danger to sit down or lie in the grass and herbage for any length of time, as the mites will then have easy access to almost any portion of the body. As a rule these creatures appear to be dependent on the shade and not to live in the direct sunlight, but some forms occur in sunny locations.

These mites are most abundant and troublesome in the Tropics, and become less numerous as we go northward. They are generally distributed in the Gulf States, up the Mississippi River to Missouri and Illinois, and through the Atlantic Coast States to northern New Jersey. They appear to be unknown in New York and New England, or north of latitude 40° in the East.

Trouble from chiggers has also been reported in portions of Tennessee and practically throughout the State of Ohio, because we have record of injury as far north as Sandusky, which is on Lake Erie, Lima, in the northern part of the State, Cincinnati, and Columbus. Reports that these creatures have also been found in other localities may and may not be true at the same time, since with the cultivation of the soil and the destruction of wild bushes and other places of harbor they have practically disappeared. There are reports also of the occurrence of chiggers at Horicon, Wis., and La Fayette, Ind., in Minnesota, and at Belvidere, S. Dak.

Several reports have been received of a plague of these mites in the vicinity of Chicago, Ill., showing similar distribution in that State. Chiggers are well distributed in Kansas, and reports would indicate similar conditions in Indiana and portions of Iowa.

Harvest mites are well known in England and Scotland under this name and as "gooseberry bugs." On the Continent of Europe, also, they are abundant, especially in Belgium and the Netherlands, in parts of Germany, and in France. Indeed, in some of these countries they have at times caused considerable annoyance to the peasantry, whom they have hindered or prevented in the harvesting of certain crops. The mites are troublesome, too, in tropical America, in the West Indies, and in Japan.

LIFE HISTORY.

The life history of a harvest mite, as related by Mr. Nathan Banks, is substantially as follows: The female lays her eggs in or upon the ground, sometimes to the number of 400 in one place. The eggs are usually brown and spherical and have been considered by some early writers as fungi. The chorion or outer skin splits soon after the eggs are deposited, dividing the eggs into halves and exposing the pale vitelline membrane. The larva when hatched is circular or ovoid in outline, and each of its three pairs of legs is tipped with two or three prominent claws. After the larva has become attached to its insect host it elongates and becomes swollen with food. When full fed it drops off, seeks a convenient shelter, and gradually changes in shape without molting. The new parts are formed under the larval skin, which after a few weeks cracks and discloses the adult Trombidium. The mature harvest mite is predaceous, wandering about and feeding on aphides, small caterpillars, and, in the case of one species, on the eggs of grasshoppers or locusts. It hibernates in the soil or in other sheltered locations and in the spring deposits its eggs. There appears to be a single generation produced each year. Only a few forms have been reared. The larva of one occurs commonly on the house fly in autumn.

REMEDIES.

As harvest-mite infestation is usually contracted by walking or working among blackberry and other shrubbery which harbors them, or by walking, sitting, or lying among grasses or similar herbage along streams or pools, on the edges of marshes, or under trees near such places, it is obvious that the best means of prevention is the avoidance of exposure by susceptible persons. If, however, a bath is taken in hot water, or water containing salt or strong soap, within a few hours after exposure, no ill effects will be experienced. After a longer exposure a bath has practically no effect, and direct remedies are necessary.

Sulphur is a sovereign remedy for mites and is the best preventive of attack. When exposure is unavoidable and where vegetation is not more than 2 or 3 feet high, a sure preventive is found in sifting flowers of sulphur into the underclothes from a little above the knee downward and into the shoes and stockings, or it may be rubbed over legs and ankles. Naphthalene has been successfully used in the same manner. While the sulphur, being inodorous and perfectly effective, is undoubtedly preferable against harvest mites alone, naphthalene is a safeguard against various forms of man-infesting tropical insect pests. Vaseline, pure or mixed with sulphur, will serve the same purpose, but is not so agreeable on account of its oily nature and the certainty of its soiling the clothing.

For most localities these precautions are to be observed through the months of July, August, and a part of September. The mites are seldom bothersome in early June or as late as October, but in exceptionally warm seasons they are apt to be encountered in both months.

If exposure has been unwittingly incurred or precautions have been neglected and the characteristic irritation has set in, warning the patient of trouble to come, a counter-irritant or cooling lotion should be applied directly to the affected parts. For this purpose moderately strong ammonia, applied when the symptoms are first manifest, has offered the best results, and the writer recommends it above all other direct remedies. Bicarbonate of soda, or common cooking soda or saleratus, may be substituted in supersaturated solution. Similar alkaline solutions would probably also serve in counteracting the insect poison, which is acid. These substances should be applied liberally until the irritation subsides. Some persons have testified to the value of a 10 per cent dilution of carbolic acid. Alcohol, camphor, essence of peppermint, and similar preparations are very "cooling," but afford, as a rule, only temporary relief. A dilute tincture of iodine or collodion applied lightly to the affected parts is a good remedy in case of severe suffering. The latter acts by protecting the "sore" spots from the air.

DESTRUCTION OF THE MITES IN THE FIELD.

Much complaint has been made of the presence of harvest mites on lawns and in vegetation in country grounds and along pathways and roadsides, and information has been solicited by many, including officers of country clubs and the like, for methods of eliminating the mites from such locations. This can be accomplished by keeping the grass, weeds, and useless herbage mowed as closely as feasible, so as to expose the mites to the sun. In some cases this can be facilitated by dusting the grass and other plants, after cutting, with flowers of sulphur or by spraying with dilute kerosene emulsion in

which sulphur has been mixed. Grasses on the borders of ponds frequented by cattle, wild blackberry bushes, and similar plants should also be cut down and destroyed in the vicinity of houses and where children and older persons are liable to mite infestation by passing through them. Well-cultivated fields kept free from weeds are not infested with "chiggers," and in the course of time, perhaps a year or two, the measures prescribed, if carefully carried out in grassy locations, should also entirely free these from the pests.

In severely chigger-infested tracts of, say, 400 acres, where there are no bushes or shrubs of value, cattle may be inadequate, and correspondents and others have stated as their experience that after turning sheep into the fields the chiggers were destroyed. Undoubtedly this was due largely to the fact that the sheep kept the grass more closely cropped than cattle would have done, but there is also a belief that the chiggers ascend the legs of the sheep and that the oil or lanoline of the wool is responsible for their death. Hence it is believed that sheep turned into large tracts such as described would accomplish the eradication of the mites more thoroughly and in a shorter space of time than would perhaps any other domestic animal, even including goats, which might be used in some cases.

For the eradication of chiggers on the grounds of wealthy private individuals and clubs the application of ordinary flowers of sulphur might be both cheaply and thoroughly made by the use of one of the dust blowers used for dusting potatoes with Paris green, or by one of the sulphur dusters used for spraying orange trees for the red spider in California. These sprayers are capable of throwing a fan-shaped discharge about 8 feet wide and effect very even and thorough distribution. The cost of application, allowing 50 pounds of sulphur per acre, should be from $1 to $1.50 per acre, and since with one man and a team 30 to 40 acres a day may be covered, the expense of application is not great. Such a duster costs from $65 to $80.

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Contribution from the Bureau of Crop Estimates, Leon M. Estabrook, Chief.

THE AGRICULTURAL OUTLOOK.

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TIME OF ISSUANCE AND SCOPE OF MAY CROP REPORT.

A summary of the May crop report of the Bureau of Crop Estimates will be issued on Friday, May 7, at 2.15 p. m. (eastern time). The report will give an estimate of the acreage of winter wheat remaining on May 1 to be harvested; the condition on May 1 of winter wheat, rye, meadow mowing lands, and pastures; farm supplies of hay on May 1; the per cent done on May 1 of the total spring plowing contemplated, and the per cent of spring planting done on May 1, 1915, with comparisons.

WINTER WHEAT AND RYE.

CONDITION AND PRICE APRIL 1, 1915.

The Crop Reporting Board of the Bureau of Crop Estimates makes the following estimates from reports of its correspondents and agents:

The average condition of winter wheat on April 1 was 88.8 per cent of a normal, against 95.6 on April 1, 1914, 91.6 on April 1, 1913, and 87.6, the average condition for the past 10 years on April 1. There was an increase in condition from December 1, 1914, to April 1, 1915, of 0.5 point, as compared with an average decline in the

past 10 years of 2.7 points between these dates. The acreage planted, as estimated last December, was 11.1 per cent larger than the acreage planted in the preceding year.

The average condition of rye on April 1 was 89.5 per cent of a normal, against 91.3 on April 1, 1914, 89.3 on April 1, 1913, and 90.1, the average condition for the past 10 years on April 1.

Comparisons for winter wheat and rye States are shown in Table 10, page 21.

FORECAST OF WINTER-WHEAT PRODUCTION.

The par, or 100 per cent normal, condition of wheat on April 1 may be regarded as equivalent to approximately 16.9 bushels per acre planted; hence a condition of 88.8 would indicate 15 bushels, which, on the 41,263,000 acres planted, would give a total production of 619,000,000 bushels, as compared with a final estimate of 684,990,000 last year, 523,561,000 two years ago, 399,919,000 three years ago, and 430,656,000 four years ago.

In forecasting this quantity of 619,000,000 bushels, it should be considered as the amount of which the probability is about equal that the outturn will be above or below it; the crop will be larger or smaller than this amount according as the changes in condition from now to harvest are better or worse than *average* changes from April 1 to harvest.

WEATHER IN GEOGRAPHIC DIVISIONS.

In a general way, the wheat crop suffered more than the average in the Atlantic Coast States as a result of a cold, dry, windy March, without adequate snow covering; in the Central States east of the Mississippi River, the crop declined slightly during the winter, but not more than usual; reports of prevalence of Hessian fly are made from many places in this section, which gives some apprehension. Great improvement in the condition was made in the western part of the grain belt, namely, in Nebraska, Kansas, and Oklahoma, which caused a general average condition on April 1 slightly higher than on December 1, although the average of the past 10 years on April 1 was 2.7 points lower than on December 1. In the Pacific Northwest large yields are anticipated.

UNITED STATES BEET-SUGAR CROP, 1914.

Details of the 1914–15 beet-sugar campaign and the three earlier ones are shown in Table 1.

TABLE 1.—*Sugar-beet and beet-sugar production in the United States, 1911–1914.*

[Figures for 1914 are subject to slight revision.]

State, and year of beet harvest.	Factories in operation.	Average length of campaign.	Sugar made (chiefly refined).	Beets used for sugar.				Analysis of beets.		Average extraction of sugar.	
				Area.	Average yield per acre.	Production.	Average price per ton.	Percentage of sucrose.[1]	Purity coefficient.[2]	Percentage of beets.	Per short ton of beets.
California:	*No.*	*Days.*	*Tons.*[3]	*Acres.*	*Tons.*[3]	*Tons.*[3]	*Dolls.*	*P. ct.*	*P. ct.*	*P. ct.*	*Lbs.*
1914	10	97	169,004	104,000	10.4	1,082,000	5.68	18.46	82.70	15.62	312
1913	12	99	171,208	127,610	8.92	1,138,003	6.10	18.04	86.26	15.05	301
1912	11	90	158,904	111,416	9.01	1,004,328	6.46	18.79	83.99	15.82	316
1911	10	98	161,300	99,545	10.42	1,037,283	5.54	18.95	82.04	15.55	311
Colorado:											
1914	13	96	220,799	135,400	12.6	1,706,300	5.68	15.35	84.22	12.94	259
1913	14	96	229,274	168,410	10.93	1,840,653	5.67	14.92	84.01	12.46	249
1912	17	91	216,010	144,999	11.32	1,641,861	5.96	16.19	84.81	13.16	263
1911	14	63	124,800	86,437	11.07	957,142	5.55	15.44	81.22	13.04	261
Idaho:											
1914	4	78	39,613	25,300	10.5	264,400	4.96	17.78	87.74	14.98	300
1913	4	77	29,620	22,497	9.90	222,612	4.99	16.24	86.35	13.31	266
1912	4	64	24,761	19,952	8.55	170,619	5.18	17.37	88.01	14.51	290
1911	3	91	26,730	17,052	12.11	206,367	5.02	16.65	88.26	12.95	259
Michigan:											
1914	15	68	110,630	101,300	8.5	857,100	5.23	15.78	82.85	12.91	258
1913	15	82	122,424	107,965	8.85	955,242	5.93	15.82	82.61	12.82	256
1912	16	74	95,049	124,241	6.75	838,784	5.69	14.72	83.75	11.33	227
1911	17	122	125,500	145,837	9.90	1,443,856	5.74	14.59	80.00	8.69	174
Ohio:											
1914	3	56	21,425	17,800	10.4	184,700	5.04	14.50	83.82	11.60	232
1913	5	80	28,687	30,661	7.84	240,435	5.34	14.46	82.95	11.93	239
1912	5	91	28,508	27,062	9.72	263,005	5.31	13.95	81.36	10.84	217
Utah:											
1914	7	100	78,619	41,300	13.7	564,600	4.79	17.08	85.60	13.92	278
1913	7	90	57,231	39,472	12.21	481,863	4.81	15.07	83.86	12.08	242
1912	6	97	59,571	37,000	12.03	445,130	4.90	16.37	86.29	13.38	168
1911	6	98	57,280	33,950	13.03	442,310	4.81	15.98	86.10	12.95	259
Wisconsin:											
1914[4]											
1913	4	57	12,553	11,800	9.66	114,000	5.80	14.10		11.01	220
1912	4	91	23,269	20,172	10.27	207,085	5.84	15.10	84.31	11.23	225
1911	4	106	23,649	23,241	11.62	256,124	5.51	14.23	81.00	9.23	185
Other States:[5]											
1914	8	76	81,964	58,300	10.8	629,500	5.67	15.80	83.35	13.02	260
1913	10	68	82,404	71,591	9.31	666,654	5.66	14.99	81.89	12.36	247
1912	10	78	86,498	70,458	9.28	653,565	5.82	16.37	83.89	13.23	265
1911[6]	12	83	80,250	67,815	10.61	719,251	5.48	15.16	84.51	11.16	223
United States:											
1914	69	85	722,054	483,400	10.9	5,288,500	5.45	16.38	83.89	13.65	273
1913	71	85	733,401	580,006	9.76	5,659,462	5.69	15.78	83.22	12.96	259
1912	73	86	692,556	555,300	9.41	5,224,377	5.82	16.31	84.49	13.26	265
1911	66	94	599,500	473,877	10.68	5,062,333	5.50	15.89	82.21	11.84	237

[1] Based upon weight of beets.
[2] Percentage of sucrose (pure sugar) in the total soluble solids of the beets.
[3] Short tons (2,000 pounds).
[4] Included with "Other States," as only 1 factory operated.
[5] The 8 factories in "Other States" in 1914 were located as follows: Indiana, 1; Illinois, 1; Wisconsin, 1; Minnesota, 1; Nebraska, 2; Kansas, 1; and Montana, 1.
[6] Including Ohio in 1911.

A rich sugar content of beets and a high percentage of extraction helped to make a good crop of beet sugar in the United States in the campaign beginning in 1914. The production amounted to 722,054 short tons, or about 11,000 tons less than in 1913. The area har-

vested in 1914 amounted to 483,400 acres, or nearly 100,000 acres less than the year before. A favorable growing season, however, resulted in an average yield per acre of nearly 11 tons, the largest since 1906 and the second largest during the 14 years covered by this department's beet-sugar reports. The average price, in spite of the lower basis for payment, reached $5.45 per ton, which was 24 cents less than the average for the preceding year.

Another noteworthy feature in the campaign beginning in 1914 was the smaller difference between the actual sugar in the beets and the actual amount extracted than in former years. In 1914 the beets averaged in content 16.38 per cent sugar, while the actual sugar made was equal to 13.65 per cent of the beets, thus leaving 2.73 per cent of the beets as representing the sugar left in pulp and in other by-products. In 1913 this nonextracted sugar was equal to 2.82 per cent of the beets and in every other preceding year the figure exceeded 3 per cent.

LOUISIANA SUGAR CROP OF 1914.

TABLE 2.—*Cane-sugar production of Louisiana, 1911–1914.*

Parish where sugar was made, and year.	Factories operating.	Sugar made.		Cane used for sugar.	Parish where sugar was made, and year.	Factories operating.	Sugar made.		Cane used for sugar.
		Quantity.	Average per short ton of cane.				Quantity.	Average per short ton of cane.	
	Number.	*Short tons.*	*Lbs.*	*Short tons.*		*Number.*	*Short tons.*	*Lbs.*	*Short tons.*
Ascension:					St. Martin:				
1914	3	5,800	138	84,000	1914	3	5,000	179	56,000
1913	4	10,808	133	163,000	1913	3	8,114	157	103,000
1912	7	8,342	134	124,934	1912	3	5,382	173	62,165
1911	7	14,496	124	234,719	1911	4	13,719	139	197,614
Assumption:					St. Mary:				
1914	17	22,500	136	331,000	1914	20	38,000	176	431,000
1913	17	28,664	124	462,000	1913	22	54,689	165	663,000
1912	16	14,457	119	243,864	1912	15	25,597	176	291,387
1911	23	35,950	107	673,263	1911	26	57,602	133	866,744
Iberia:					Terrebonne:				
1914	7	8,000	165	97,000	1914	13	23,900	162	295,000
1913	10	15,925	156	204,000	1913	13	24,631	140	352,000
1912	9	10,999	156	140,932	1912	14	14,463	150	191,984
1911	13	29,949	129	464,491	1911	14	27,462	124	442,218
Iberville:					West Baton Rouge:				
1914	15	18,900	134	283,000	1914	11	16,300	152	214,000
1913	14	19,187	122	315,000	1913	10	15,305	136	225,000
1912	11	7,942	112	141,581	1912	10	9,328	147	127,196
1911	18	23,759	99	481,545	1911	10	17,235	110	314,472
Lafourche:					Lafayette and Vermilion:				
1914	13	34,300	153	447,000	1914	6	14,900	183	163,000
1913	13	35,021	131	535,000	1913	6	23,104	168	276,000
1912	9	11,728	122	191,714	1912	6	14,547	177	164,580
1911	16	42,001	119	707,764	1911	5	23,480	140	336,427
St. James:					Other parishes:[1]				
1914	16	16,900	131	258,000	1914	17	24,300	146	333,000
1913	17	19,970	122	327,000	1913	16	23,684	134	353,000
1912	10	9,368	97	192,537	1912	11	10,131	158	127,910
1911	20	20,760	115	361,537	1911	24	31,526	119	530,962
St. John:					Total Louisiana:				
1914	8	13,900	134	207,000	1914	149	242,700	152	3,199,000
1913	8	13,596	115	236,000	1913	153	292,698	139	4,214,000
1912	5	11,289	140	161,790	1912	126	153,573	142	2,162,574
1911	8	14,935	108	275,536	1911	188	352,874	120	5,887,292

[1] Avoyelles, Rapides, St. Landry, East Baton Rouge, Pointe Coupee, West Feliciana, Jefferson, Orleans, Plaquemines, and St. Charles.

NOTE.—The average yield per acre of cane used for sugar in Louisiana was 15 short tons in 1914; 17 in 1913; 11 in 1912; and 19 tons in 1911. One short ton equals 2,000 pounds.

The sugar crop of Louisiana for the season just closed amounted to 242,700 short tons, or practically 50,000 less than in 1913. The yield per acre of the cane used for this sugar was 15 tons in 1914, or 2 tons less than in 1913. More sugar, however, was obtained per ton of cane in 1914 than in the preceding year, and in fact more than in any other of the four years for which this department has made report. The 1914 season was one of a light tonnage of cane per acre and comparatively large sugar content.

About one-half of the 1914 output of Louisiana sugar consisted of grades above 96° polarization and ready for immediate sale to the trade. In 1912 and 1913 only one-third of the total output consisted of grades above 96°.

Details of the campaigns of 1914 and three preceding years are shown in Table 2, which is based upon reports for all operating factories. (See p. 4.)

THE SUGAR SUPPLY.

By FRANK ANDREWS, *Chief of Division of Crop Records.*

PRODUCTION IN CONTINENTAL UNITED STATES.

Favorable crop conditions resulted in a total production in the United States (excluding Texas) of practically 965,000 short tons of sugar in 1914. The production in 1913 on a much larger acreage amounted to 1,025,000 short tons. Four years ago, in the campaign beginning in 1910, the production amounted to 853,000 tons; in 1905 it was 689,000, and in 1901, 545,000 tons. Texas produced in 1909, according to the census, nearly 8,000 tons, and the production in 1914 was probably much less.

IMPORTS FROM FOREIGN COUNTRIES AND INSULAR POSSESSIONS.

From three-fourths to four-fifths of the sugar used in the United States is brought from foreign countries and the insular possessions. The net receipts from these sources during the calendar year 1914 amounted to 3,419,000 short tons; in the preceding year, 3,253,000; in 1912, 3,030,000; and in 1911, 2,934,000 short tons. Shipments out of the United States are generally small, rarely above 50,000 tons a year. In the calendar year 1914, however, over 208,000 tons were shipped to foreign countries and about 8,000 to Hawaii and Porto Rico. Imports of foreign sugar were large in 1914, amounting to 2,535,000 tons as against 2,337,000 in 1913, 2,017,000 in 1912, and 1,866,000 in 1911.

Receipts from Hawaii in the calendar year 1914 were 605,000 tons, an increase of practically 67,000 over the preceding year; receipts from Porto Rico amounted to 321,000, or 54,000 less than in 1913; while imports from the Philippine Islands reached 174,000 tons, which was 130,000 over the abnormally low figure of 1913 and 33,000 above 1912. The Hawaiian crop, all but a small fraction of which comes to this country, reached 612,000 short tons during the year

ending September 30, 1914. This was an increase of more than 65,000 tons over the preceding year, and was the largest on record. Details concerning this crop are given in Farmers' Bulletin 665, pages 5 and 6.

All but a relatively small part of the foreign sugar brought to this country comes from Cuba. The present campaign in Cuba, which is about half over (April 1), promises a somewhat lower yield than a year ago, according to unofficial reports.

SUGAR PRICES.

Prices March 25, 1915, showed granulated sugar at New York 5.8 cents per pound, as compared with 3.8 a year ago, 4.2 about the same date 1913, and 5.3 about the end of March, 1912. The price of raw sugar of 96 degrees polarization had reached 4.95 cents per pound by March 25, 1915, which was exactly 2 cents above the quotation of one year ago, and 0.59 of 1 cent over the price March 28, 1912.

EUROPEAN BEET-SUGAR IN 1914.

The International Institute of Agriculture, reporting for the 1914 beet-sugar campaign up to the end of December, gives the following figures for the production of 1914 expressed as percentages of the 1913 crop: Austria 100.5, Hungary 86.0, Netherlands 128.0, Roumania 111.3, Sweden 107.3, and Switzerland 116.5. The large producing countries—Germany, France, and Russia—it will be noted, as well as Denmark, Belgium, and Italy, are not included in this report. Austria and Hungary together, however, produce normally about 1,500,000 to 2,000,000 short tons, about four-fifths of which is made in Austria.

APPROXIMATE COMMERCIAL APPLE CROP, 1914.

TABLE 3.—*Apple crops of 1913 and 1914: Percentage shipped out of counties where grown.*

[Figures for 1913 were based upon reports from the State aids; for 1914 from reports of the field agents and township correspondents. Bulk shipments, as well as barrel and box shipments, are included.]

Geographic division.	From crop of—	
	1913	1914
	Per cent.	*Per cent.*
New England	47	44
Middle Atlantic	53	42
South Atlantic	32	33
North Central east of Mississippi River	36	21
North Central west of Mississippi River	20	21
South Central east of Mississippi River	8	16
South Central west of Mississippi River	34	39
Rocky Mountain	61	45
Pacific	55	52
United States	41	38

Shipments out of counties are estimated to equal about 59,600,000 bushels from the 1913 crop and 98,400,000 bushels from the 1914 crop.

FLORIDA AND CALIFORNIA CROPS.

The condition on April 1, with comparisons, of the principal crops in Florida and California, on the basis of 100 representing a normal, is shown in Table 4.

TABLE 4.—*Florida and California crop reports.*

Item.	Florida.				California.			
	Apr. 1—			Mar. 1, 1915.	Apr. 1—			Mar. 1, 1915.
	1915	1914	1913		1915	1914	1913	
Orange trees	90	102	95	92	98	98	.....	98
Lemon trees	.....	.....	.....	.....	99	94	.....	97
Lime trees	90	100	100	90	.....	.....	.....	.....
Grapefruit trees	92	101	97	93	.....	.....	.....	.....
Pineapples	90	80	92	86	.....	.....	.....	.....
Peaches	83	85	88	.....	.....	.....	.....	.....
Pears	85	82	79	.....	.....	.....	.....	.....
Strawberries	84	90	90	.....	.....	.....	.....	.....
Pasture	75	87	95	82	.....	.....	.....	.....
Cabbages	90	82	92	85	.....	.....	.....	.....
Tomatoes	74	80	87	65	.....	.....	.....	.....
White potatoes	79	92	95	89	.....	.....	.....	.....
Celery	.....	.....	.....	.....	[1] 98	[1] 96	[1] 92	91
Cauliflower	.....	.....	.....	.....	96	94	94	94

[1] Production compared with a full crop.

TREND OF PRICES OF FARM PRODUCTS.

The level of prices paid producers of the United States for the principal crops increased about 0.2 per cent during March; in the past seven years the price level has increased during March 1.6 per cent.

On April 1 the index figure of crop prices was about 7.5 per cent higher than a year ago, 27 per cent higher than two years ago, and 10.5 per cent higher than the average of the past seven years on April 1.

The level of prices paid to producers of the United States for meat animals on March 15 was the same as on February 15. This compares with an average increase from February 15 to March 15 in the past five years of 3.7 per cent.

On March 15 the average (weighted) price of meat animals—hogs, cattle, sheep, and chickens—was $6.46 per 100 pounds, which compares with $7.37 a year ago, $7.08 two years ago, $5.69 three years ago, $6.09 four years ago, and $7.39 five years ago on March 15.

A tabulation of prices is shown in Tables 11 to 13.

THE WORLD WHEAT ACREAGE IN 1915.

By CHARLES M. DAUGHERTY.

MOVEMENT TO INCREASE WINTER-WHEAT PRODUCTION.

Rapidly advancing prices, excited markets, and enormous transactions in wheat during the past seven months in most countries, vague apprehensions of the eventual exhaustion of supplies in others,

and a subconscious realization of the calamitous consequences that might result from any material shortage in the world crop in 1915 have, with other causes, given great impetus to an almost universal movement to expand the acreage seeded for the approaching harvest. The effects of that impetus are now to some extent apparent.

Sowings of winter wheat in the Northern Hemisphere have, in so far as known, been pretty generally on an extensive scale, excepting in some of the European countries involved in war. In the United States, British India, and Canada the area sown last autumn was increased by about 8,500,000 acres over that of the year before; there was also some expansion in the neutral countries of southwestern Europe; but to what extent these increases may have been counteracted, or annulled, by the contraction of autumn seedings in northern and eastern Europe, due to the scarcity of rural labor and animal power and to the occupation of farm land by military forces, is not yet determinable.

REDUCTION IN COUNTRIES AT WAR.

The aggregate acreage ordinarily sown to winter wheat in the contending countries of Europe is about 55,000,000 acres. A reduction in that acreage of over 15 per cent would be necessary to offset the 8,500,000 acres increase in the aggregate sowings of the three exporting countries mentioned above. That there has been a reduction is generally admitted. Doubt arises only as to its extent. The area under wheat in the British Isles is officially estimated as larger than in 1914; the Russian acreage is a little less extensive than last year. Belgium is not an important wheat producer and Germany's acreage, usually only about 5,000,000 acres, is, it is claimed, a large one.

It is therefore apparent that whatever contraction there may have been in the winter-wheat acreage of the countries at war has occurred for the most part in France, Austria-Hungary, and Serbia. Their aggregate winter-wheat area in time of peace is normally about 29,000,000 acres.

SPRING-WHEAT ACREAGE.

In view of these and other facts, it seems logical that, weather and labor conditions favoring, there would be a heavy extension this season in the sowing of spring wheat. Of the approximately 240,000,000 acres of wheat in the world, between 85,000,000 and 90,000,000 are of this variety. Practically the entire crop is the product of three countries—Russia (including Asiatic), the United States, and Canada. Russia in the best years sows about 60,000,000 acres, the United States 20,000,000 acres (last year 17,533,000), and Canada 10,000,000 acres (9,320,000 in 1914). Though the next most important producing countries are France and Germany, their combined acreage in average years is less than a million acres. In other European countries than those mentioned spring-wheat culture is ordinarily

on such a small scale as to be almost negligible. The cultivation of this variety is not popular either in the States of central or western Europe. Even in France and Germany increases above the normal area are usually due to the failure of winter wheat in localities.

LARGE INCREASE OF SPRING-WHEAT ACREAGE IN 1915 NOT INDICATED.

Though no definite figures upon the extent sown in the different countries this spring have yet been published, present indications do not point to the heavy increase in the world's acreage that was at one time anticipated. Owing to the prolonged closing of the Dardanelles and most other routes of export, the surplus wheat still remaining in Russia from the last harvest is believed to be very heavy. The depressing effect of this unexported surplus upon the Russian markets, together with the strained labor situation and other abnormal economic conditions incident to the war, seem to be having a restraining influence upon seeding operations; late commercial reports suggest a probable reduction in the Russian spring-wheat area of 10 to 15 per cent. Should this expectation be realized, it will go far toward neutralizing the heavy increase in sowings expected in all other spring-wheat countries combined, and leave the world's acreage little, if any, larger than that of last year.

AVERAGE SOWINGS PER ACRE IN EUROPE AND AMERICA.

By CHARLES M. DAUGHERTY.

EUROPEAN SOWINGS ARE LARGER.

In most, and probably in all, European countries it is quite the general custom to sow, on an average, a larger quantity of wheat and other cereals per acre than is sown either in the United States or in other countries of the Western Hemisphere. What amount to sow per unit of surface in order to produce the best results is in all countries a mooted question. Variations in an agricultural usage of this kind can not, of course, be rigidly outlined by State boundaries. They arise, rather, from differences in climate and character of soil, from extensive or intensive systems of farming, from diverse economic causes, and even from precedent, local tradition, etc. Political boundaries alone rarely differentiate the agricultural methods and customs of neighboring peoples.

In the quantity of seed sown per acre, however, there is an appreciable difference between the customs of western, central, and eastern Europe—a more striking one still between those of the Continent of Europe, as a whole, and of the countries of America.

In Great Britain, though the quantity of wheat seeded per acre varies in different localities with the quality of the soil, weather con-

ditions at seed time, tillering habits of varieties grown, methods of sowing, and features of cultivation, farmers drill on an average about 2 bushels per acre of winter wheat and 3 of spring. Years ago, when broadcasting was more common, the general average for winter wheat was as much as 2½ bushels. Seedings in France, Belgium, and the Netherlands are, for the most part, on a like liberal scale, the winter variety being sown at the average rate of 2 bushels per acre and over, and the spring somewhat more heavily. The tendency in the warmer latitudes of Italy and Spain is to plant less thickly, the general average in the former being 1.9 bushels and 2 bushels in the latter.

Wheat farming in the principal producing countries of central and eastern Europe, though yields per acre are in general smaller than in the northwestern part of that Continent, is also characterized by generous seedings. In Austria, Roumania, and Bulgaria the average rate per acre is probably greater than in any other European country, and amounts, for winter wheat—practically the only variety raised—to upward of 2.5 bushels; the average in Hungary is 2.2 bushels per acre.

Great local variations in the quantity sown naturally occur in a country where conditions of climate and soil are so diversified as in European Russia. The average per acre for the entire country, however, is officially given as a trifle less than 2 bushels for winter wheat and 1.6 bushels for spring. An unusual feature of Russian seeding is that a smaller quantity of spring wheat is sown per unit of surface than of the winter variety; in most countries of Europe the opposite is true.

IN THE WESTERN HEMISPHERE.

From various and not always obvious reasons farmers in the Western Hemisphere seed less abundantly. In the United States, according to an estimate of the Department of Agriculture, the bulk of the wheat sowings in 1912 ranged, by States, between 1.25 and 1.75 bushels per acre, the general average of the entire Republic being only 1.38 bushels. The average per acre in Canada, doubtless due partly to the fact that the bulk of the crop is spring wheat, is heavier, and, taking one year with another, amounts to about 1.6 bushels. In the Argentine Republic and in Uruguay very moderate seeding is the practice, the average in each country being, respectively, about 1.2 and 1 bushel per acre. The standard in Chile presents a rather remarkable exception to that of the neighboring Republics, grain being sown at a rate per acre similar to that adopted in European countries.

BUSHELS SOWN PER ACRE IN MANY COUNTRIES.

The following statement, from official sources, shows the average quantity of wheat, rye, barley, and oats sown per acre in various

nations. The figures do not represent the average sowings for a uniform series of years in each country, but are designed to represent the situation, in so far as figures are available.

TABLE 5.—*Average quantity of wheat, rye, barley, and oats sown per acre in undermentioned countries.*

[Bushels: Wheat, 60; rye, 56; barley, 48; and oats, 32 pounds.]

Countries.	Wheat sown.	Rye sown.	Barley sown.	Oats sown.
EUROPE.	*Bu. per acre.*	*Bu. per acre.*	*Bu. per acre.*	*Bu. per acre.*
Great Britian	2.00	3.00	2.60	4.07
Ireland	2.33	3.00	2.92	5.25
France	2.10	2.00	2.50	2.34
Italy	1.86	2.23	1.86	3.35
Spain	2.00	1.91	2.60	2.37
Belgium	[1] 2.29 [2] 2.45	2.28	2.71	4.26
Netherlands	2.26	2.82	1.75	2.87
Switzerland	2.97	2.71	1.70	4.74
Austria	[1] 2.53 [2] 2.74	2.71	2.79	4.46
Hungary	2.20	2.15	2.56	3.32
Roumania	2.53	2.63	2.79	3.35
Bulgaria	[1] 3.21 [2] 2.38	[1] 3.06 [2] 3.03	[1] 3.44 [2] 2.60	4.10
Russia in Europe	[1] 1.97 [2] 1.57	[1] 2.17 [2] 2.05	2.34	4.50
AMERICA.				
United States	1.38	1.44	1.84	2.37
Canada	1.62	1.50	2.00	2.69
Argentina	1.19	.....	.74	[3] 1.11
Chile	2.50	.....	3.16	[4] 4.23
Uruguay	.97	.....	.....	1.87
OTHER.				
Australia	.97	.87	1.30	2.03
New Zealand	2.00	.....	3.00	3.00
Japan	.88	.....	1.18	1.05
Egypt	2.76	.....	2.59	.....

[1] Winter. [2] Spring. [3] Average, 1908-1912. [4] Average, 1908-9 to 1912-13.

WAGON HAULS FOR FARM PRODUCTS.

By FRANK ANDREWS, *Chief of Division of Crop Records.*

AVERAGE DISTANCE AND TRIPS PER DAY.

An inquiry just completed by the Bureau of Crop Estimates shows an average distance from market of 6.5 miles for the farms of the United States, while those farthest away from market (excluding of course the rarer instances) average 8.7 miles. The number of round trips per day averages for all farms 2.1, and for the more remote farms 1.6 trips; in other words, it requires about one-half a day for the average farmer to make a round trip with wagon from farm to market and back, and averages nearly two-thirds of a day for the farmers who are farthest from market.

The averages and the details shown in Table 6 are based upon reports from township and county correspondents and traveling field agents of the Bureau of Crop Estimates.

COMPARISON OF CORN, WHEAT, AND COTTON.

In comparing the figures for individual States it will be noted that the longer hauls are generally in the cotton States and in the Rocky Mountain region. It will be noted also that the smaller loads are in the cotton States. The average size of a wagonload of cotton in the United States is 3 bales, or about 1,500 pounds, while the average wagonload of wheat is 53.5 bushels, or 3,200 pounds. In the cotton country loads of corn and wheat are much smaller than in other parts of the United States, possibly due to the fact that the principal product hauled influences greatly the size of load for other products in the same region. It is interesting to note that while the size of the cotton load is much smaller than that of the corn load, the value of the former is very much greater; the average value of a load of cotton, based on farm prices December 1, 1913, was $183; for wheat, $43; and for corn, $28. The higher the price of a given product the smaller is the load which the farmer can afford to haul. Also the more valuable the product the longer is the haul which can be profitably made.

WAGON HAULS SHORTER THAN NINE YEARS AGO.

In 1906 the Bureau of Crop Estimates (then the Bureau of Statistics) of the Department of Agriculture made an inquiry through county correspondents as to wagon hauls for farm products (see Bulletin 49, Bureau of Statistics). The figures for 1906 are not strictly comparable with those for 1915, but it is evident that wagon hauls are shorter than they were nine years ago. In 1906 the average haul from farm to shipping point was, for wheat, 9.4 miles; corn, 7.4; oats, 7.3; potatoes, 8.2; and cotton, 11.8 miles; each of these staple crops was hauled a longer distance in 1906 than the general average haul in 1915 (6.5 miles). It is noted also that the average number of round trips per day for all farm-to-market hauls was 2.1 in 1915. In 1906 the average number of round trips per day for hauling wheat was 1.2; for corn, 1.7; and for cotton, 1.0.

Railroad building during the past nine years has brought some farms nearer to shipping points and markets, and has helped to shorten the average distance hauled and to increase the average number of trips per day. During the seven years following 1906 more than 32,000 miles of new railroad were built, and several thousand more miles have been added since 1913, so that there are at least 15 per cent more miles of steam railroads in the United States now than in 1906. In addition to this new mileage of steam railroads, the hauls of some farmers have no doubt been shortened by new freight-carrying electric railroads.

TIME REQUIRED.

The number of days required to haul from farms the marketed portion of the corn, wheat, and cotton crops is estimated in Table 6. It would require about 6,358,000 days for one wagon, or about 6,358,000 wagons for one day, to haul from farms the marketed portion of an average corn crop; the corresponding figure for wheat is about 6,857,000, and for cotton 2,532,000.

COST OF WAGON HAULING.

The time required is an element in the cost of producing and marketing crops. From the farmer's point of view it is an element of cost of production. The cost of hauling was not estimated for 1915. A simple schedule of inquiry was desired in order to obtain a large number of returns for the most important items related to hauling, and extra questions weaken an investigation by reducing the number of replies. However, in 1906 the estimated cost of hauling per day for each wagon averaged: For wheat, $3.60; corn, $3; and cotton, $2.80. Wages of farm labor are higher in 1915 than in 1909. No figures for wages are available for 1906. Prices of feed in the winter of 1914–15 were much higher than in 1906–7. Farm prices, on December 1, for hay averaged for the United States $10.37 per ton in 1906 and $11.12 in 1914; corn, 39.9 cents per bushel in 1906 and 63.7 in 1914; and oats, 31.7 and 43.8 cents per bushel for the respective dates. The farm value of horses on January 1 averaged $93.51 per head in 1907 and $103.33 in 1915. These increases indicate a considerable rise in the average cost per day to the farmer of hauling his products.

This higher cost per day is offset partly or wholly by the larger quantities hauled per day in 1915 compared with 1906. For instance, in 1906 an average day's haul of wheat was 1.2 loads of 55 bushels each, or a total of 56.1 bushels per day; in 1915 a day's haul averages 2.1 loads of 53.5 bushels each, or a total of 112.4 bushels per day. Similar increases occurred in regard to corn and cotton. An average day's haul of cotton moved about 1,700 pounds in 1906 and about 3,000 pounds in 1915. Figures for average loads of corn in 1915 are not comparable with those for 1906. The improvement of wagon roads during the past nine years has probably helped to increase the average quantity of farm products moved by a day's wagon haul.

TABLE 6.—*Hauling crops from farms: Distance, time, and size of load.*

[These figures refer to wagon hauls from farms to all points at which products are delivered by farmers.]

State.	Average for all farms, 1915.	Average for the more remote farms, 1915.		Average size of wagon load, 1915.			Estimated time spent in hauling from farms in an average year.[1]		
	Distance to market one way.	Distance to market one way.	Round trips per day.	Corn (unshelled).	Wheat.	Cotton (ginned).	Corn.	Wheat.	Cotton.
	Miles.	*Miles.*	*Number.*	*Bushels.*	*Bushels.*	*Bales.*	*Days.*	*Days.*	*Days.*
Maine	5.5	8.0	1.6	54	53	.....	600	600	.....
New Hampshire	5.0	7.5	1.2	54	50	.....	400	.....	.....
Vermont	5.8	8.0	1.2	54	48	.....	200	300	.....
Massachusetts	6.0	9.0	1.4	51	50	.....	.....	.....	.....
Rhode Island	6.0	8.1	1.3	47	35	.....	500	.....	.....
Connecticut	4.7	6.6	1.4	52	47	.....	1,400	.....	.....
New York	5.0	7.0	1.7	55	48	.....	3,400	53,400	.....
New Jersey	5.5	7.5	1.8	50	48	.....	13,600	11,000	.....
Pennsylvania	5.5	7.5	1.7	55	48	.....	78,000	184,900	.....
Delaware	4.5	5.2	2.0	40	45	.....	26,800	18,700	.....
Maryland	6.0	7.5	1.8	55	50	.....	51,500	89,700	.....
Virginia	7.8	10.4	1.5	34	36	2.5	81,100	122,700	4,600
West Virginia	7.0	9.0	1.3	37	34	.....	29,400	54,700	.....
North Carolina	7.5	10.0	1.5	26	26	3.0	99,600	107,900	132,200
South Carolina	6.0	9.0	1.5	22	24	3.3	51,700	13,400	185,700
Georgia	6.9	8.6	1.7	21	25	3.3	113,200	24,300	331,200
Florida	7.0	8.0	1.9	17	.....	2.3	30,300	.....	11,800
Ohio	4.0	6.3	1.8	45	53	.....	257,300	130,500	.....
Indiana	4.3	7.0	1.5	41	54	.....	456,500	174,000	.....
Illinois	4.1	5.5	2.3	40	48	.....	1,020,400	163,100	.....
Michigan	5.3	7.5	1.6	58	49	.....	43,200	95,200	.....
Wisconsin	5.3	7.5	1.5	45	46	.....	43,900	32,800	.....
Minnesota	5.5	7.0	1.6	40	49	.....	100,600	488,300	.....
Iowa	4.5	5.5	1.8	45	48	.....	983,200	119,400	.....
Missouri	6.5	9.0	1.4	30	39	3.0	435,700	397,400	11,500
North Dakota	7.0	9.4	1.3	58	66	.....	1,400	897,000	.....
South Dakota	8.0	10.0	1.5	41	56	.....	202,900	353,100	.....
Nebraska	7.0	9.0	1.6	38	58	.....	534,200	521,000	.....
Kansas	5.8	7.5	1.8	38	53	.....	171,200	1,002,700	.....
Kentucky	7.5	10.0	1.2	28	38	.....	346,300	142,800	.....
Tennessee	7.0	9.0	1.6	26	33	3.0	285,700	120,900	61,400
Alabama	7.5	10.5	1.3	21	25	2.8	58,000	7,000	293,300
Mississippi	8.0	10.0	1.3	20	25	2.7	125,500	.....	298,800
Louisiana	6.0	8.0	1.8	25	32	3.0	64,300	.....	61,700
Texas	7.5	11.0	1.2	27	42	3.0	262,700	150,800	747,400
Oklahoma	7.6	10.0	1.3	30	50	2.8	263,100	360,500	178,400
Arkansas	7.5	10.0	1.5	22	30	2.5	85,900	19,000	214,600
Montana	10.6	13.5	1.2	43	63	.....	.....	181,200	.....
Wyoming	12.5	15.5	1.0	42	56	.....	.....	30,000	.....
Colorado	10.0	12.0	1.2	40	55	.....	12,900	131,800	.....
New Mexico	14.0	16.5	1.2	33	43	.....	13,800	23,800	.....
Arizona	8.0	11.5	1.7	43	55	.....	1,800	5,600	.....
Utah	11.0	14.0	1.0	60	62	.....	200	78,800	.....
Nevada	18.0	25.0	.8	.....	60	.....	.....	17,500	.....
Idaho	6.8	10.5	1.5	50	66	.....	400	89,200	.....
Washington	7.5	9.1	1.5	60	80	.....	200	304,100	.....
Oregon	7.5	16.5	1.2	45	65	.....	300	102,400	.....
California	8.0	12.5	1.5	70	70	8.0	4,900	35,900	1,200
United States	6.5	8.7	1.6	40.5	53.5	3.0	6,358,200	6,857,400	[2] 2,532,300

[1] Based upon corn and cotton crops of 1913, and average of the wheat crops of 1912 and 1914. Quantity hauled: For corn = the crop × percentage marketed; for wheat = the crop, less seed; for cotton = the crop.

[2] Including 1,500 days for States of very small production.

CONCENTRATING AND STORAGE-IN-TRANSIT ARRANGEMENTS IN TRANSPORTING FARM PRODUCTS.

By T. F. POWELL, *Investigator in Transportation of Farm Products, Office of Markets and Rural Organization.*

The lack of proper assembling methods is one of the chief difficulties encountered in a successful solution of the marketing problem. In localities where suitable common or cold storage facilities are available, the growers of farm products would find the concentration and storage-in-transit privileges two of the most desirable means for bringing about the widest distribution. Shippers, as a rule, are not familiar with these arrangements; if they were utilized more frequently it would enable shippers to move their freight to market in carload lots, thus securing the benefit of the lowest rates and the quickest service.

Concentration is defined as the shipment in less than carloads of certain commodities to certain points, after which the shipments are reforwarded in carload lots.

Storage in transit is defined as the shipment in carloads to storage points of freight which has already been combined into carload lots under or independent of the concentrating arrangement.

The concentrating privilege at the present time is confined largely to butter, cheese, eggs, and poultry and permits of grading, mixing, repacking, and storing. Under this arrangement live poultry in carloads is frequently shipped to a concentrating point and dressed poultry in carload lots is forwarded from such concentrating point. In some cases special any-quantity rates are provided to concentrating points. In other cases the carload rate in effect from original point of shipment to final destination is applied plus an additional charge of 5 or 10 cents or more.

The storage privilege is allowed on all of the above commodities, and concentrated carload shipments of such commodities forwarded from a concentrating point in some sections may be stopped once in transit for storage. *Storage in transit* independent of the concentrating privilege is allowed also on green apples in packages, onions, potatoes, celery, hay, grapes, and other produce in carload lots for periods varying from six months to a year.

The privilege is granted free of charge in rare instances. Usually an additional charge of from 1½ to 3 cents per 100 pounds is made. Ordinarily the shipments pay full tariff rate to the storage point and when reshipped the charges are adjusted on the basis of the through rate in effect at date of original shipment from point of origin to final destination plus the storage charge. Where both the concentrating and storage privileges are used, a separate charge for each privilege is made.

The *concentrating privilege* can be utilized most successfully in cases where several small points of production of a particular commodity in certain districts are somewhat widely separated. It would be of advantage in such cases to concentrate small shipments and combine them into carload shipments at certain points and move them from these concentration points to distant markets, or, by also utilizing the *storage-in-transit privilege* to put the freight into storage at some convenient point and afterwards move it to final destination at the carload rate. Arrangements of this kind would enable small producing points to reach markets which otherwise would be out of reach, and would benefit the railroads by giving them a long haul on the traffic.

Concentrating rates are also of advantage to the railroads by increasing the size and regularity of shipments. They benefit the shippers by enabling them to secure the carload rates, to avoid handling in transit, to secure quicker service and to permit them to supply the markets at times when their products are most in demand.

Both of the privileges are susceptible of much greater development in all sections and should be encouraged by the railroads. It would be well worth while for the railroads, as well as associations of shippers in various sections, to make a closer study of the suitability of such arrangements in particular localities. Such a study should be of especial interest to the shippers in the South, where many new problems connected with the distribution of new products must constantly arise for solution as crop diversification progresses.

If any shippers feel that either of these transit privileges would be of benefit and are prepared to supply suitable warehouse facilities, they should then arrange to confer with officials of the interested railroads. In this way a friendly discussion would develop as to how the arrangements could be made to fit any particular local conditions.

Shippers should always keep in mind, however, that service is the only thing the railroads have to sell and they should be willing to pay the railroads a fair additional charge for this or any other benefit which involves any extra cost on the part of the railroads, and which renders the service more valuable to the shippers.

LIVE STOCK LOSSES AND CONDITION.

The losses from disease of live stock in the United States amount to about $150,000,000 a year. This figure is based upon the average rate of loss during the past 30 years applied to numbers and values of live stock January 1 last. The losses from exposure, estimated in the same way, amount to about $44,000,000 a year. In the past few years loss from disease is somewhat greater than the figure given above, largely on account of the hog cholera epidemic; but losses from exposure have been diminishing in recent years by reason of better shelter and care.

TABLE 7.—*Condition of farm animals and number of breeding sows, April 1, 1915, with comparisons.*

State.	Horses.			Cattle.			Sheep.			Swine.			Breeding sows.[1]
	1915	1914	10-year average.	1915	1914	10-year average.	1915	1914	10-year average.	1915	1914	10-year average.	
	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.	P. c.
Maine	99	98	98	99	98	98	99	98	98	98	97	98	102
New Hampshire	99	99	98	98	97	98	99	99	98	99	93	97	110
Vermont	99	99	99	98	98	98	97	99	98	98	97	99	105
Massachusetts	99	97	98	97	98	97	98	99	97	97	97	97	100
Rhode Island	99	99	98	98	97	97	97	99	98	99	96	98	100
Connecticut	99	97	98	98	97	98	98	98	98	97	96	98	103
New York	98	98	98	97	97	97	98	97	97	98	96	98	102
New Jersey	98	98	97	97	97	95	98	96	95	97	96	97	105
Pennsylvania	98	97	97	96	97	96	96	95	95	96	95	96	102
Delaware	98	97	96	97	97	95	96	97	94	94	90	95	105
Maryland	97	95	95	96	94	95	96	95	94	95	93	94	104
Virginia	96	97	95	95	95	94	94	93	93	95	94	94	104
West Virginia	97	96	95	95	95	94	95	91	92	96	96	95	102
North Carolina	97	96	96	96	95	93	96	94	92	97	93	94	107
South Carolina	96	95	94	94	92	91	94	92	92	93	91	93	112
Georgia	96	96	96	95	96	92	93	93	91	95	95	94	112
Florida	97	97	95	90	94	90	94	97	92	91	93	92	108
Ohio	97	97	96	97	97	95	96	95	94	95	91	94	102
Indiana	97	95	96	97	97	95	96	94	94	93	91	93	102
Illinois	96	96	98	95	97	97	97	95	96	93	92	94	102
Michigan	98	97	96	98	97	96	97	96	95	96	93	95	102
Wisconsin	98	97	97	98	98	96	98	97	96	97	97	97	100
Minnesota	98	98	97	98	98	97	98	97	97	94	88	96	115
Iowa	97	98	98	96	98	97	96	97	97	93	89	96	105
Missouri	93	95	95	94	94	94	94	93	93	89	89	91	101
North Dakota	99	97	97	98	98	96	98	98	97	96	94	98	120
South Dakota	97	97	97	96	98	96	95	98	96	94	90	96	115
Nebraska	98	97	97	97	97	95	98	96	96	93	89	95	110
Kansas	97	95	95	96	94	94	97	94	95	93	91	93	110
Kentucky	96	94	94	96	94	93	95	93	91	93	90	92	105
Tennessee	95	95	95	94	94	93	95	94	92	92	89	93	107
Alabama	95	96	95	93	94	91	93	93	92	94	92	94	107
Mississippi	95	95	94	92	95	90	92	95	89	94	95	93	105
Louisiana	95	94	94	89	94	90	90	93	92	89	88	91	105
Texas	95	95	94	96	97	92	95	96	94	95	94	95	108
Oklahoma	96	96	94	96	96	93	98	97	93	88	91	91	103
Arkansas	92	95	92	91	94	90	93	92	91	87	89	89	101
Montana	98	99	97	98	98	94	98	99	96	98	97	98	100
Wyoming	99	100	98	99	100	96	99	100	95	98	101	99	112
Colorado	99	98	97	98	97	95	98	97	95	98	98	98	110
New Mexico	97	96	94	96	92	93	95	92	93	99	97	95	120
Arizona	96	96	94	95	96	93	97	97	95	98	96	97	130
Utah	99	97	97	99	98	96	99	98	97	99	97	98	110
Nevada	97	99	96	98	98	96	98	98	97	99	99	98	115
Idaho	98	99	97	99	99	97	99	98	97	98	95	98	93
Washington	99	99	97	98	98	97	99	100	98	98	99	98	97
Oregon	98	99	98	99	99	98	99	99	98	98	100	99	95
California	99	98	98	98	98	96	99	98	97	98	97	97	105
United States	96.6	96.4	96.1	96.2	96.5	94.6	97.1	96.6	95.2	93.5	91.6	94.2	105.2

[1] Number compared with Apr. 1, 1914.

Table 8 shows the estimated losses during the year 1913 and what would be the losses last year if the average rate of loss for 30 years were applied to numbers and values January 1, 1915:

TABLE 8.—*Losses of live stock from disease and exposure.*

	1913			Theoretical average loss, average rate applied to numbers and values January 1.		
	Rate per 1,000.	Number loss.	Value.	Average rate per 1,000.	Number loss.	Value.
From disease:						
Horses	20.6	523,000	$58,000,000	19.2	493,000	$52,000,000
Cattle	19.8	1,123,000	44,000,000	19.5	1,137,000	47,000,000
Sheep	21.7	1,080,000	4,000,000	29.4	1,057,000	5,000,000
Swine	118.9	7,005,000	73,000,000	77.5	5,008,000	49,000,000
Total	.....	.....	179,000,000	.....	.....	153,000,000
From exposure:						
Cattle	10.9	614,000	24,000,000	16.3	951,000	39,000,000
Sheep	21.0	1,044,000	4,000,000	31.8	1,144,000	5,000,000
Total	.....	.....	28,000,000	.....	.....	44,000,000

The rates of losses here given were based upon replies from many thousand reporters to the following question: "About how many in every thousand (1,000) have died during the year ending March 31?" This year the form of the question was altered, reading "How many per hundred (100), etc.," instead of per thousand. The returns indicate clearly that many reporters assumed that the question was the same as had been asked for many years past and reported a figure ten times too high. Therefore the results obtained this year are not comparable with estimates previously obtained and in consequence are not published.

The written comments of agents and reporters indicate that during the past year the losses of hogs from cholera were still larger than in a normal year, but smaller than in the preceding year; the disease is being better controlled and losses are diminishing. The losses of swine from disease in the year ending March 31, 1914, were estimated at 119 per thousand, and it is probable that the losses last year were 100 per thousand, and possibly a little less. It may be remembered that a year ago Iowa lost 25 per cent of her hogs and Minnesota and South Dakota each more than 20 per cent. The losses in the past year have been but little more than half as much. However, in a section comprised by Missouri, Arkansas, Oklahoma, and Kansas losses the past year appear to be slightly heavier than in the preceding year. About 90 per cent of swine losses from disease is due to cholera.

The condition of live stock on April 1, 1915, with comparisons, is shown in Table 7, 100 representing a normal condition of healthfulness. It will be observed from this tabulation that on April 1 the

condition of horses was higher than a year ago and higher than the 10-year average; the condition of cattle was slightly lower than a year ago, but still above the 10-year average; the condition of sheep was higher than any previous date shown; and the condition of hogs, although still below the average, was higher than a year ago and two years ago, indicating the diminishing of cholera. The comparatively high condition of cattle, notwithstanding the outbreak of foot-and-mouth disease, indicates that drastic measures have resulted beneficially in keeping this dangerous disease in check. The actual losses of cattle during the year from foot-and-mouth disease, although severe in individual herds, does not bulk large in comparison with usual losses from disease; the average yearly loss of cattle from all diseases is nearly 2.0 per cent of the total supply; the losses from foot-and-mouth disease probably will not exceed 0.002 per cent of the total supply.

TABLE 9.—*Condition of live stock in the United States on dates indicated; 100=normal.*

	Horses.	Cattle.	Sheep.	Swine.
Apr. 1, 1915	96.6	96.2	97.1	93.5
Apr. 1, 1914	96.4	96.5	96.6	91.6
Apr. 1, 1913	96.7	96.0	96.0	91.4
Apr. 1, 1912	93.6	91.5	92.9	89.9
Apr. 1, 1911	96.7	95.9	96.2	95.9
Apr. 1, 1910	95.8	94.6	93.6	95.4
Average 1905–1914	96.1	94.6	95.2	94.2

Sheep wintered unusually well in the western sheep section; losses were smaller than usual and their condition above average.

In general, with the exception of hog cholera and foot-and-mouth disease, the past year was more favorable than usual for live stock; swine losses are becoming less and foot-and-mouth disease is believed to be nearly stamped out.

APPLES IN COLD STORAGE APRIL 1, 1915, AND PROGRESS OF MOVEMENT.

[Contribution from the Office of Markets and Rural Organization.]

Reports as of April 1, 1915, have been received from 270 cold storages having an approximate capacity of 6,286,482 barrels, showing the quantity of barreled and boxed apples held by them on that date and on the same date in 1913. Comparison with similar reports received on December 1, January 1, February 1, and March 1, give the following results:

	Barrels.	Boxes.	Equivalent in barrels.
In storage April 1, 1915	611,383	781,228	871,792

Of the 270 storages reporting on April 1, only 195, having an approximate capacity of 4,677,951 barrels, reported their holdings on April 1, 1913. Their holdings were as follows:

	Barrels.	Boxes.	Equivalent in barrels.
In storage April 1, 1915	414,723	642,673	628,947
In storage April 1, 1913	479,651	795,547	744,833

From the above, it appears that there were 15.6 per cent less apples in storage on April 1, 1915, than on April 1, 1913.

Of the 270 storages reporting for April 1, only 250, having an approximate capacity of 6,021,682 barrels, reported on March 1. Their holdings on these dates were as follows:

	Barrels.	Boxes.	Equivalent in barrels.
In storage Mar. 1, 1915	1,187,769	1,350,500	1,637,936
In storage Apr. 1, 1915	608,404	757,674	860,962

The decrease during March, 1915, is 579,365 barrels and 592,826 boxes, which is equivalent to 776,974 barrels.

This is a decrease of 48.8 per cent in barreled apples and 43.9 per cent in boxed apples, or a total of 47.4 per cent of all apples in storage March 1, 1915.

Of the 270 storages reporting for April 1, only 216, having an approximate capacity of 5,381,402 barrels, reported on December 1, January 1, February 1, and March 1. Their holdings on these dates were as follows:

	Barrels.	Boxes.	Equivalent in barrels.
In storage Dec. 1, 1914	2,122,978	2,274,235	2,881,056
In storage Jan. 1, 1915	1,865,815	2,122,206	2,573,217
In storage Feb. 1, 1915	1,458,761	1,865,420	2,060,568
In storage Mar. 1, 1915	1,011,300	1,312,002	1,448,634
In storage Apr. 1, 1915	512,965	728,062	755,652

These 216 firms show a decrease during December, 1914, of 12.1 per cent barreled apples and 6.7 per cent boxed apples, or a total decrease of 10.7 per cent.

During January, 1915, the holdings of barreled apples decreased 19.2 per cent, and boxed apples 11.3 per cent, equivalent to a decrease of 17.1 per cent in the total holdings as of December 1.

During February, 1915, the holdings of barreled apples decreased 21.1 per cent, and boxed apples 24.3 per cent, equivalent to a decrease of 21.9 per cent in the total holdings as of December 1.

During March, 1915, the holdings of barreled apples decreased 23.5 per cent, and boxed apples 25.7 per cent, equivalent to a decrease of 24.1 per cent in the total holdings as of December 1.

During the months of December, 1914, January, 1915, February, 1915, and March, 1915, taken together, the decrease was 75.9 per cent in barreled apples and 68 per cent in boxed apples, or a total decrease of 73.8 per cent since December 1, 1914.

During March an effort was made to secure complete storage holdings as of the first of each month, beginning December 1, for all firms reporting. This permits comparisons of the holdings of 216 cold storages for five months.

This office will endeavor to issue on May 10 a similar statement for the month of April.

CONDITION AND PRICE OF WINTER WHEAT AND RYE.

TABLE 10.—*Winter wheat and rye: Acreage sown in fall of 1914; condition and price paid to producers Apr. 1, 1915, with comparisons.*

State.	Winter wheat.								Rye.					
	Acreage sown.		Condition.				Price per bushel Apr. 1—		Condition.				Price per bushel Apr. 1—	
			Apr. 1—						Apr. 1—					
	Per cent of last year.	Area sown fall of 1914 (000 omitted).	1915	1914	10-year average.	Dec. 1, 1914.	1915	1914	1915	1914	10-year average.	Dec. 1, 1914.	1915	1914
	P.ct.	*Acres.*	*P.ct.*	*P.ct.*	*P.ct.*	*P.ct.*	*Cts.*	*Cts.*	*P.ct.*	*P.ct.*	*P.ct.*	*P.ct.*	*Cts.*	*Cts.*
Vermont	.....	.....	.....	.....	.....	.....	.....	.....	94	98	94	95	85	70
Massachusetts	.....	.....	.....	.....	.....	.....	.....	.....	93	96	92	92	105	93
Connecticut	.....	.....	.....	.....	.....	.....	.....	.....	91	94	96	94	104	80
New York	105	382	86	95	90	96	138	97	86	94	91	92	113	72
New Jersey	98	81	74	91	91	82	141	97	83	91	92	85	105	75
Pennsylvania	102	1,366	78	93	90	85	138	95	82	94	91	87	95	76
Delaware	110	128	83	91	92	88	140	97	85	90	92	89	.....	75
Maryland	106	658	81	93	91	89	147	95	80	91	91	90	85	74
Virginia	160	1,270	85	95	91	93	146	101	86	95	91	93	96	84
West Virginia	110	265	86	94	89	92	139	101	78	93	91	93	93	87
North Carolina	175	1,097	85	92	92	95	144	112	84	92	91	96	101	98
South Carolina	300	246	84	89	88	96	147	116	88	89	89	96	130	175
Georgia	218	314	86	91	89	94	144	122	89	92	90	96	112	115
Ohio	105	2,101	87	96	83	94	141	93	91	96	86	96	99	68
Indiana	112	2,820	90	97	84	89	141	91	92	96	88	93	96	63
Illinois	115	2,934	90	98	86	92	133	88	93	97	91	94	105	62
Michigan	107	963	85	92	85	92	137	92	89	91	88	95	98	60
Wisconsin	100	89	90	85	89	96	130	82	93	87	91	97	107	55
Minnesota	105	59	89	83	.....	94	133	83	90	88	89	96	100	51
Iowa	103	536	94	95	90	96	126	79	95	93	94	97	98	62
Missouri	110	2,844	86	98	87	87	134	86	91	96	90	92	101	74
North Dakota	.....	.....	.....	.....	.....	.....	132	81	87	87	84	92	102	48
South Dakota	110	95	97	87	.....	93	123	79	96	88	90	94	96	51
Nebraska	105	3,637	96	93	90	90	131	75	100	92	92	93	99	57
Kansas	98	8,779	89	96	87	80	130	80	92	95	88	90	94	65
Kentucky	115	883	79	96	88	89	140	98	82	94	88	92	105	84
Tennessee	120	872	81	97	90	90	136	101	82	93	89	92	102	102
Alabama	285	97	85	93	90	93	148	111	82	91	90	95	132	150
Mississippi	225	2	84	95	88	93	.....	.....	.....	.....	.....	.....	.....	.....
Texas	120	1,367	89	92	84	89	130	95	90	81	80	92	114	104
Oklahoma	120	3,092	90	97	85	83	133	81	94	97	88	90	117	93
Arkansas	144	184	89	95	88	90	131	88	89	93	88	88	90	65
Montana	135	683	96	93	94	98	126	71	96	94	96	98	94	61
Wyoming	115	54	96	94	96	90	126	86	95	97	96	90	81	64
Colorado	105	276	92	94	94	92	115	78	93	92	92	93	94	56
New Mexico	115	55	96	94	93	95	129	79	.....	95	90	.....	.....	.....
Arizona	125	41	97	95	95	98	155	109	102	101	96	.....	.....	.....
Utah	110	253	92	99	96	89	124	73	95	96	97	90	71	55
Nevada	120	23	95	95	99	88	160	90	.....	100	99	.....	.....	.....
Idaho	114	394	93	98	97	95	105	68	89	97	98	94	65	90
Washington	110	1,174	95	97	93	100	120	80	100	100	95	100	90	60
Oregon	108	686	94	102	94	93	127	86	96	98	97	96	120	85
California	110	463	95	95	88	98	129	97	98	100	92	100	110	110
U. S.	111.1	41,263	88.8	95.6	87.6	88.3	131.7	84.2	89.5	91.3	90.1	93.6	100.4	63.0

PRICES OF FARM PRODUCTS.

TABLE 11.—*Prices paid to producers of farm products, by States.*

State.	April 1.															
	Corn, per bushel.		Oats, per bushel.		Barley, per bushel.		Buckwheat, per bushel.		Potatoes, per bushel.		Hay, per ton.		Flaxseed, per bushel.		Cotton, per pound.	
	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year aver. age.	1915	5-year average.
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Dolls*	*Dolls*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Maine	93	76	65	56	85	83	.....	71	25	57	14.00	14.52	.....	.....	.....	.....
New Hampshire	84	72	66	55	83	87	80	75	38	72	13.00	16.74	.....	.....	.....	.....
Vermont	81	72	62	54	90	86	87	89	42	68	15.20	14.60	.....	.....	.....	.....
Massachusetts	80	77	61	55	.....	.....	.....	88	57	82	19.50	20.04	.....	.....	.....	.....
Rhode Island	.....	92	.....	.....	.....	.....	.....	.....	45	92	23.00	21.92	.....	.....	.....	.....
Connecticut	87	73	67	50	.....	.....	100	91	52	87	20.40	21.04	.....	.....	.....	.....
New York	84	71	62	49	79	77	87	73	36	69	15.10	15.42	.....	.....	.....	.....
New Jersey	83	72	63	48	.....	.....	84	76	51	84	19.70	19.84	.....	.....	.....	.....
Pennsylvania	85	69	60	49	80	69	82	69	50	74	14.80	16.68	.....	.....	.....	.....
Delaware	73	64	.....	44	.....	.....	.....	.....	70	91	17.50	18.30	.....	.....	.....	.....
Maryland	78	68	61	49	65	63	95	73	56	74	16.70	16.78	.....	.....	.....	.....
Virginia	93	78	69	57	79	68	98	82	72	82	18.70	17.42	.....	.....	8.1	13.4
West Virginia	91	79	65	57	.....	.....	85	76	84	90	17.60	16.48	.....	.....	.....	.....
North Carolina	95	88	73	65	.....	.....	83	84	89	96	18.40	17.10	.....	.....	8.1	12.6
South Carolina	99	93	74	67	.....	.....	.....	.....	129	135	17.40	18.54	.....	.....	8.4	12.7
Georgia	93	90	73	67	.....	.....	.....	.....	109	120	17.70	17.88	.....	.....	8.2	12.7
Florida	94	88	74	71	.....	.....	.....	.....	119	142	17.60	17.42	.....	.....	11.0	15.7
Ohio	74	58	55	40	63	64	115	75	49	71	13.70	14.16	.....	.....	.....	.....
Indiana	68	54	53	39	68	64	71	79	56	71	14.20	13.84	.....	.....	.....	.....
Illinois	69	55	55	38	71	67	.....	97	68	79	14.50	14.06	.....	.....	.....	.....
Michigan	72	60	51	41	80	69	75	67	28	50	12.00	13.88	.....	.....	.....	.....
Wisconsin	72	56	55	39	72	72	87	72	31	49	10.10	12.82	.....	177	.....	.....
Minnesota	62	48	50	35	61	65	82	64	37	53	6.80	7.90	168	173	.....	.....
Iowa	64	50	51	35	66	66	98	95	63	78	12.90	10.82	130	160	.....	.....
Missouri	75	60	58	44	.....	68	105	96	84	92	14.70	11.88	140	157	7.0	11.2
North Dakota	66	57	48	35	57	57	.....	.....	46	62	5.60	6.54	172	174	.....	.....
South Dakota	59	49	47	36	60	61	.....	.....	52	77	7.10	7.38	158	171	.....	.....
Nebraska	64	51	48	37	55	57	100	73	61	85	8.30	9.06	139	.....	.....	.....
Kansas	73	59	51	45	60	60	.....	.....	87	103	8.00	9.72	158	143	.....	.....
Kentucky	80	72	68	54	87	76	.....	.....	81	88	7.40	16.00	.....	.....	.....	.....
Tennessee	83	73	63	56	90	82	78	77	104	99	18.20	15.80	.....	.....	7.9	12.3
Alabama	93	86	72	66	116	.....	.....	.....	105	122	15.10	14.82	.....	.....	8.0	12.6
Mississippi	87	80	67	63	.....	.....	.....	.....	111	125	12.60	12.58	.....	.....	7.8	12.5
Louisiana	93	74	75	59	.....	.....	.....	.....	112	107	12.00	13.02	.....	.....	8.0	12.2
Texas	96	80	59	54	60	73	.....	.....	115	120	10.40	12.58	.....	.....	8.2	12.1
Oklahoma	80	63	55	49	64	60	.....	.....	100	112	8.40	9.56	.....	.....	7.8	11.7
Arkansas	93	77	64	58	.....	.....	.....	.....	106	110	13.20	13.52	.....	.....	7.9	12.2
Montana	96	93	50	41	78	63	.....	.....	66	72	8.80	10.44	170	169	.....	.....
Wyoming	85	78	55	51	79	75	.....	.....	84	92	8.30	9.56	140	.....	.....	.....
Colorado	71	63	49	48	63	63	.....	.....	54	63	7.00	10.44	.....	.....	.....	.....
New Mexico	125	94	80	51	95	73	.....	.....	155	109	10.50	13.06	.....	.....	.....	.....
Arizona	125	105	74	74	85	78	.....	.....	139	129	10.00	13.44	.....	.....	16.0	.....
Utah	84	79	54	47	60	60	.....	.....	64	69	8.30	9.90	.....	.....	.....	.....
Nevada	.....	.....	67	60	99	86	.....	.....	78	88	7.80	11.00	.....	.....	.....	.....
Idaho	92	78	42	41	66	56	.....	.....	54	57	7.20	8.50	.....	.....	.....	.....
Washington	80	81	48	44	59	58	.....	.....	60	60	11.50	12.74	.....	.....	.....	.....
Oregon	85	83	50	45	80	66	.....	.....	62	64	9.80	10.94	.....	.....	.....	.....
California	99	83	50	53	68	69	.....	.....	80	84	8.80	11.80	.....	.....	7.0	.....
United States	75.1	62.1	53.4	40.5	64.7	64.3	85.3	72.2	47.8	68.1	11.64	12.95	167.7	173.2	8.1	12.4

TABLE 11.—*Prices paid to producers of farm products, by States*—Continued.

State.	April 1.						March 15.									
	Butter, per pound.		Eggs, per dozen.		Chickens, per pound.		Hogs, per 100 pounds.		Beef cattle, per 100 pounds.		Veal calves, per 100 pounds.		Sheep, per 100 pounds.		Lambs, per 100 pounds.	
	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.	1915	5-year average.
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*										
Maine	31	30	19	21	14.2	14.4	$7.20	$7.78	$7.00	$7.00	$8.70	$7.92	$5.20	$4.30	$6.70	$6.00
New Hampshire	33	31	20	22	15.0	14.3	7.20	7.80	6.40	6.02	8.60	7.74	5.40	5.12	7.00	7.02
Vermont	32	31	19	21	13.4	13.6	6.50	7.52	5.40	5.12	7.40	6.70	4.20	3.94	6.00	5.92
Massachusetts	33	34	25	26	17.2	16.4	7.20	8.38	5.90	5.92	8.40	8.32	.....	.....	.....	.....
Rhode Island	36	33	20	24	18.0	17.9	7.50	8.46	6.30	6.20	9.00	7.96	5.30	.....	7.60	6.67
Connecticut	35	34	21	24	18.6	16.2	8.00	8.35	6.50	6.98	9.50	8.90	6.00	5.82	7.80	7.85
New York	31	30	20	21	15.6	14.8	6.90	7.76	5.70	5.20	9.30	8.34	4.70	4.28	7.20	6.46
New Jersey	34	33	22	23	17.4	16.9	8.30	8.86	6.30	6.78	10.00	8.98	6.50	4.30	9.00	.....
Pennsylvania	29	30	18	20	14.5	13.7	7.30	8.08	6.70	6.20	8.70	8.04	5.60	4.98	7.30	6.56
Delaware	30	29	20	18	13.5	14.0	6.80	7.77	5.90	5.75	9.80	9.35	5.00	5.12	6.00	7.28
Maryland	29	28	17	18	14.5	14.8	7.50	7.80	7.00	5.78	8.70	8.68	.....	.....	.....	.....
Virginia	26	25	16	17	13.6	13.5	6.90	7.58	5.90	5.14	7.80	7.38	4.60	4.20	7.00	6.42
West Virginia	27	26	18	18	13.0	11.9	6.80	7.84	6.40	5.52	7.60	7.16	4.90	4.50	6.80	5.82
North Carolina	24	24	15	15	11.2	11.1	7.50	7.38	5.00	4.22	6.00	5.34	4.80	4.10	5.80	4.86
South Carolina	26	26	17	19	12.2	12.2	7.50	7.40	4.40	4.00	5.00	4.54	5.10	4.64	6.00	5.82
Georgia	25	25	16	18	12.7	12.6	6.90	7.50	4.20	3.78	5.20	4.70	5.10	4.55	5.50	5.48
Florida	34	32	21	22	15.6	14.4	6.30	6.78	5.20	5.04	6.50	5.88	6.00	5.30	7.00	.....
Ohio	26	25	17	17	12.6	12.1	6.50	7.86	6.50	6.00	8.00	8.06	5.10	4.58	7.40	6.50
Indiana	24	23	16	16	11.9	11.5	6.50	7.84	6.40	5.68	7.60	7.36	4.60	4.32	7.10	6.26
Illinois	25	25	16	16	11.7	11.5	6.30	7.64	6.40	5.82	8.10	7.32	5.50	4.64	7.20	6.16
Michigan	26	26	18	19	12.1	11.9	6.20	7.66	6.10	5.36	8.30	7.52	5.00	4.68	7.70	6.64
Wisconsin	28	28	17	17	11.9	11.3	6.20	7.56	5.20	4.94	7.70	7.22	5.30	4.50	7.00	6.08
Minnesota	26	26	16	16	10.0	10.0	6.10	7.44	5.50	4.86	7.10	6.50	4.90	4.38	6.50	5.80
Iowa	26	25	16	16	10.4	10.1	6.20	7.64	6.50	6.18	7.50	6.84	5.40	4.74	7.00	6.12
Missouri	23	22	16	15	11.4	11.0	6.10	7.32	6.30	5.76	7.00	6.62	5.30	4.62	7.00	5.84
North Dakota	23	22	16	16	10.3	9.8	5.60	6.94	5.30	4.58	6.80	6.12	5.20	4.50	6.70	5.62
South Dakota	23	22	16	15	9.2	8.7	5.90	7.26	6.00	5.40	7.10	6.18	5.40	4.62	7.00	5.90
Nebraska	22	22	15	16	10.0	9.7	6.00	7.36	6.50	5.98	7.80	6.94	6.40	5.38	7.70	6.60
Kansas	22	22	15	15	10.0	9.6	6.20	7.40	6.50	5.96	7.80	6.98	6.10	5.14	7.70	6.20
Kentucky	21	21	15	15	11.3	11.1	6.20	7.32	5.90	5.12	7.20	6.52	4.10	3.76	6.30	5.48
Tennessee	21	20	14	15	11.5	10.9	6.20	7.02	5.50	4.46	6.50	5.66	4.10	3.68	5.90	5.34
Alabama	21	21	14	15	12.2	11.4	6.50	7.06	4.00	3.44	4.90	4.32	4.20	4.45	4.80	5.85
Mississippi	22	23	15	16	11.3	11.5	5.70	6.52	4.20	3.68	5.30	5.00	4.30	3.82	5.80	5.00
Louisiana	27	27	16	18	13.4	12.7	6.10	6.12	4.90	4.00	5.70	4.78	4.60	3.62	5.30	4.88
Texas	22	22	14	14	9.9	9.1	6.20	6.86	5.50	4.36	6.20	5.60	5.00	4.30	6.00	5.18
Oklahoma	22	21	14	15	10.0	9.4	5.90	7.16	5.60	5.02	6.90	6.26	5.30	5.08	6.00	6.04
Arkansas	23	22	15	15	9.7	9.8	5.40	6.12	4.50	4.04	5.70	5.52	4.00	3.74	4.70	4.70
Montana	32	33	21	25	13.2	14.4	6.10	7.70	6.50	6.08	8.00	8.18	5.80	5.38	7.50	6.50
Wyoming	30	31	23	24	14.0	13.5	6.40	7.72	6.40	5.64	9.70	7.54	6.00	5.12	7.20	6.46
Colorado	27	29	19	21	13.2	13.1	6.50	7.46	6.60	5.60	8.90	7.38	5.90	4.54	7.60	5.80
New Mexico	32	34	21	26	14.2	13.2	6.60	7.60	6.40	5.48	8.70	7.44	5.10	4.66	6.70	6.20
Arizona	30	36	21	27	16.0	17.8	6.70	7.48	6.20	5.48	7.50	6.30	.....	.....	.....	.....
Utah	30	29	18	17	13.4	12.2	6.50	6.92	6.10	5.20	8.60	7.92	5.80	4.60	7.20	6.48
Nevada	35	38	29	31	22.0	19.9	7.30	8.25	6.30	6.18	7.20	7.12	5.30	5.10	6.80	6.50
Idaho	26	30	17	22	10.2	12.0	6.10	7.26	5.70	5.48	7.30	7.68	5.00	5.12	6.10	6.08
Washington	31	32	19	21	13.1	14.1	6.50	8.00	6.20	5.64	8.40	8.06	6.00	5.22	7.20	6.45
Oregon	30	33	20	21	12.6	13.2	6.60	7.90	6.20	5.88	7.50	7.52	5.70	4.86	6.60	5.72
California	27	31	20	19	15.5	14.6	6.80	7.44	6.30	6.24	7.70	6.80	5.90	5.22	7.00	6.12
United States	25.8	25.4	16.6	17.1	11.9	11.5	6.33	7.41	5.92	5.29	7.50	6.92	5.36	4.79	6.06	6.22

TABLE 11.—*Prices paid to producers of farm products, by States*—Continued.

State.	March 15.															
	Milch cows, per head.		Horses, per head.		Wool, per pound.		Timothy hay, per ton.	Clover hay, per ton.	Alfalfa hay, per ton.	Prairie hay, per ton.	Cotton seed, per ton.		Apples, per bushel.		Peanuts, per pound.	
	1915	5-year average.	1915	5-year average.	1915	1914	1915	1915	1915	1915	1915	1914	1915	1914	1915	1914
	Dolls	*Dolls*	*Dolls*	*Dolls*	*Cts.*	*Cts.*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Maine	55.70	51.34	202	186	24	20	14.10	11.50	.....	.....	.....	.....	56	110	.....	.....
New Hampshire	60.00	52.54	187	174	22	17	17.40	15.00	.....	.....	.....	.....	70	150	.....	.....
Vermont	55.50	47.32	168	161	25	18	13.90	14.00	.....	.....	.....	.....	78	150	.....	.....
Massachusetts	72.20	55.65	193	199	.....	.....	20.50	18.20	.....	.....	.....	.....	82	140	.....	.....
Rhode Island	77.50	65.50	200	.....	23	17	22.50	.....	.....	.....	.....	.....	88	160	.....	.....
Connecticut	71.70	60.62	200	214	23	22	20.00	17.50	.....	.....	.....	.....	80	125	.....	.....
New York	65.00	55.94	180	176	25	18	15.50	13.00	15.80	9.80	.....	.....	53	110	.....	.....
New Jersey	68.20	60.78	176	184	25	20	19.50	16.50	.....	.....	.....	.....	60	160	.....	.....
Pennsylvania	60.10	51.44	164	175	23	20	14.90	13.20	15.20	.....	.....	.....	60	115	.....	.....
Delaware	51.40	48.00	120	142	.....	.....	18.60	16.00	.....	.....	.....	.....	70	150	.....	.....
Maryland	55.00	41.52	112	141	.....	.....	15.70	13.00	.....	.....	.....	.....	55	135	.....	.....
Virginia	47.60	39.12	134	142	24	20	19.50	18.00	20.20	.....	30.70	34.50	54	118	3.3	4.5
West Virginia	53.20	43.18	144	142	25	20	19.30	17.50	23.00	.....	.....	.....	57	160	.....	.....
North Carolina	39.00	34.30	149	150	20	19	22.30	20.10	23.00	.....	24.50	27.40	80	100	3.9	4.0
South Carolina	38.30	36.10	148	170	17	16	24.80	24.20	26.00	17.40	25.20	28.00	100	160	5.0	5.0
Georgia	37.00	32.42	143	158	20	20	21.40	19.70	22.20	15.00	25.90	26.20	110	180	5.1	5.5
Florida	43.20	40.04	135	150	19	18	24.00	22.50	.....	.....	22.00	25.50	.....	.....	4.5	5.0
Ohio	58.40	52.82	159	170	26	19	14.40	13.00	15.50	.....	.....	.....	73	150	.....	.....
Indiana	54.10	49.20	136	153	23	19	15.70	13.90	16.10	8.80	.....	.....	97	125	.....	.....
Illinois	63.80	54.66	143	154	21	17	15.90	14.50	16.50	12.00	.....	.....	105	130	.....	.....
Michigan	59.60	48.62	170	174	26	19	12.10	10.40	13.90	.....	.....	.....	69	100	.....	.....
Wisconsin	61.40	53.12	164	168	23	18	10.80	9.50	13.00	6.70	.....	.....	107	160	.....	.....
Minnesota	58.10	47.30	148	164	19	15	9.60	9.00	10.00	6.60	.....	.....	125	183	.....	.....
Iowa	60.30	53.20	148	164	22	17	13.80	13.00	15.70	11.70	.....	.....	125	150	.....	.....
Missouri	56.40	49.14	110	127	20	18	15.40	14.20	15.80	12.00	26.70	.....	100	140	.....	.....
North Dakota	62.20	48.84	134	154	15	15	9.00	11.00	11.00	6.40	.....	.....	.....	.....	.....	.....
South Dakota	61.70	49.96	120	143	20	15	10.50	12.00	11.00	7.10	.....	.....	150	230	.....	.....
Nebraska	66.60	53.58	123	134	24	15	10.40	10.60	9.50	8.40	.....	.....	120	160	.....	.....
Kansas	66.10	52.20	123	130	.....	.....	11.80	10.10	10.20	8.40	.....	.....	120	190	.....	.....
Kentucky	48.00	41.02	110	131	24	19	18.60	17.20	19.50	.....	.....	.....	95	130	.....	.....
Tennessee	43.90	38.34	124	146	20	18	19.70	18.70	19.80	14.70	24.60	24.40	95	150	4.4	4.0
Alabama	36.30	32.04	119	137	16	15	.....	.....	23.50	13.70	24.50	26.70	105	150	4.7	5.0
Mississippi	38.30	32.32	112	122	16	16	.....	.....	21.20	10.50	23.80	24.30	.....	.....	4.0	4.8
Louisiana	38.10	31.34	90	102	15	14	.....	.....	16.00	9.20	20.60	18.20	.....	.....	2.5	3.5
Texas	55.30	43.80	89	96	15	14	.....	.....	16.00	10.20	19.00	20.30	125	150	4.5	5.0
Oklahoma	56.80	47.12	101	112	20	15	.....	.....	11.90	8.60	18.80	21.10	130	170	4.9	5.5
Arkansas	41.60	33.18	91	112	17	16	18.90	17.50	17.20	11.40	20.00	19.50	105	160	4.6	4.5
Montana	80.00	62.46	128	136	26	18	11.40	9.50	9.50	10.00	.....	.....	95	.....	.....	.....
Wyoming	83.60	60.42	110	106	24	15	10.40	8.20	8.00	11.00	.....	.....	240	.....	.....	.....
Colorado	75.40	55.84	118	120	25	17	11.50	11.50	8.30	8.50	.....	.....	80	120	.....	.....
New Mexico	68.20	53.36	78	92	19	13	15.00	.....	10.30	10.30	.....	.....	105	175	.....	.....
Arizona	100.00	77.25	90	116	26	17	.....	.....	14.00	.....	.....	.....	226	240	.....	.....
Utah	66.50	48.66	118	109	25	15	9.50	10.00	8.00	7.00	.....	.....	80	110	.....	.....
Nevada	83.30	61.55	130	168	24	14	20.00	.....	14.50	.....	.....	.....	150	200	.....	.....
Idaho	76.00	57.66	116	130	24	16	9.80	8.50	7.30	6.70	.....	.....	85	115	.....	.....
Washington	70.30	63.50	119	151	18	15	12.50	11.20	10.50	.....	.....	.....	66	115	.....	.....
Oregon	69.30	54.36	100	120	23	15	11.00	9.00	8.30	7.20	.....	.....	90	100	.....	.....
California	74.80	55.90	117	135	18	12	.....	.....	9.00	.....	.....	.....	75	150	.....	.....
United States	58.00	48.90	131.60	143.94	22.8	16.4	14.28	13.41	9.79	8.03	22.32	23.60	73.4	128.9	4.2	4.7

TABLE 11.—*Prices paid to producers of farm products, by States*—Continued.

State.	March 15.																			
	Honey, comb, per pound.		Honey, extract, per pound.		Maple sugar, per pound.		Maple sirup, per gallon.		Hops, per pound.		Beans, per bushel.		Cabbages, per 100 pounds.		Onions, per bushel.		Sweet potatoes, per bushel.		Broom corn, per ton.	
	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Dolls*	*Dolls*
Me....	19	20	18	20	19.0	20.0	123	125	....	....	3.59	2.85	1.15	1.82	95	108	....	....	.....	.....
N. H.	20	20	22	21	16.0	15.0	111	110	....	....	3.50	2.74	1.40	2.25	78	150	....	....	.....	.....
Vt....	19	18	20	16	10.5	11.5	106	100	....	....	3.40	2.40	1.50	2.62	80	167	....	....	.....	.....
Mass..	18	20	....	....	17.5	19.0	109	110	....	....	3.05	3.38	1.10	2.00	71	165	....	....	.....	.....
R. I..	....	....	15	15	....	....	....	....	....	....	3.25	.....	1.10	1.55	70	170	....	....	.....	.....
Conn.	18	18	15	....	....	....	....	....	....	....	3.50	2.45	1.65	1.50	67	144	....	....	.....	.....
N. Y..	14	15	14	12	13.0	12.0	102	105	8	30	3.10	2.35	.50	1.15	68	150	....	....	.....	.....
N. J..	16	20	15	17	....	....	....	....	....	....	3.27	2.75	1.00	1.80	65	140	118	75	.....	.....
Pa....	17	15	12	11	14.4	13.4	105	105	....	....	3.10	2.36	1.50	2.50	85	130	125	140	.....	.....
Del...	15	14	16	....	....	....	....	....	....	....	3.25	2.60	1.75	1.90	93	130	108	50	.....	.....
Md....	19	....	....	....	....	....	....	....	....	....	3.30	2.25	1.10	1.88	75	100	....	....	.....	.....
Va....	14	14	14	13	14.0	14.0	105	100	....	....	3.03	2.65	1.80	2.50	105	105	91	82	.....	.....
W.Va.	18	16	14	14	15.5	16.0	112	120	....	....	3.08	2.83	2.00	2.50	120	140	125	130	.....	.....
N. C..	14	14	14	15	18.0	16.0	94	100	....	....	2.74	2.39	1.50	2.50	98	91	85	75	.....	.....
S. C....	13	14	15	14	....	....	....	....	....	....	2.62	2.70	2.30	2.42	140	160	88	86	.....	.....
Ga	11	12	11	12	....	....	....	....	....	....	2.95	2.85	2.10	2.50	135	190	80	85	.....	.....
Fla....	12	11	8	....	....	....	....	....	....	....	3.00	2.65	2.10	2.30	160	185	74	85	.....	.....
Ohio..	16	17	11	14	12.8	13.5	109	110	....	....	3.14	2.40	1.50	2.40	75	150	115	130	.....	.....
Ind....	17	17	16	16	17.0	15.0	127	125	....	....	3.14	2.50	1.75	2.25	90	140	110	125	.....	.....
Ill....	15	15	14	12	20.0	24.0	140	133	....	....	3.15	2.50	1.80	2.45	100	170	120	115	85	120
Mich..	15	15	10	10	15.0	14.0	126	120	....	....	2.75	1.68	1.25	2.00	59	110	....	....	.....	.....
Wis....	14	14	10	10	15.5	14.0	140	125	....	....	2.88	2.05	1.50	2.20	96	150	....	....	.....	.....
Minn.	15	15	11	15	19.0	15.0	150	125	....	....	2.88	2.10	1.85	2.80	100	145	....	....	.....	.....
Iowa..	16	15	13	12	....	....	140	110	....	....	3.50	2.50	2.60	3.60	115	150	150	128	.....	.....
Mo	16	15	13	12	20.0	19.0	114	110	....	....	3.33	2.70	2.50	3.10	130	165	115	135	.....	.....
N. Dak	20	....	....	....	....	....	....	....	....	....	3.10	2.90	3.10	4.00	165	190	....	....	.....	.....
S. Dak	14	17	15	14	....	....	....	....	....	....	3.08	2.78	3.50	3.70	140	188	....	....	.....	.....
Nebr..	17	15	13	12	....	....	....	....	....	....	3.11	2.50	2.30	3.05	135	160	155	....	.....	.....
Kans.	16	17	11	16	....	....	....	....	....	....	3.42	2.80	2.40	2.70	125	200	120	150	73	76
Ky....	15	15	14	15	18.7	20.0	131	128	....	....	2.92	2.40	1.90	2.65	110	130	105	110	.....	.....
Tenn.	14	13	15	14	20.0	19.0	102	105	....	....	2.88	2.60	2.00	2.50	100	110	100	100	.....	.....
Ala....	11	11	12	12	....	....	....	....	....	....	2.70	2.35	1.90	2.00	160	165	88	85	.....	.....
Miss..	11	12	12	11	....	....	....	....	....	....	....	....	1.80	3.20	130	170	80	75	.....	.....
La....	12	12	10	11	....	....	....	....	....	....	....	....	2.60	2.25	100	142	69	75	.....	.....
Tex...	11	12	10	12	....	....	....	....	....	....	3.12	3.00	2.20	2.40	160	200	110	115	60	.....
Okla..	15	15	11	12	....	....	....	....	....	....	3.07	2.85	2.50	3.60	160	165	120	120	65	89
Ark..	12	13	12	13	....	....	....	....	....	....	3.25	2.65	2.90	3.00	125	170	100	105	.....	.....
Mont.	12	12	10	....	....	....	....	....	....	....	3.24	3.30	1.80	2.50	100	150	....	....	.....	.....
Wyo..	15	12	11	10	....	....	....	....	....	....	3.16	3.00	2.25	4.00	200	230	....	....	.....	.....
Colo..	12	11	8	7	....	....	....	....	....	....	2.66	2.10	1.30	2.00	60	175	....	....	.....	.....
N. Mex	12	12	11	10	....	....	....	....	....	....	2.78	2.70	2.25	2.95	180	210	165	190	.....	.....
Ariz..	....	13	12	8	....	....	....	....	....	....	3.15	2.55	2.40	3.15	....	.....	110	200	.....	.....
Utah..	12	10	8	8	....	....	....	....	....	....	3.37	3.45	1.90	2.90	125	200	....	....	.....	.....
Nev..	12	12	8	8	....	....	....	....	....	....	....	.....	2.50	3.30	130	164	....	....	.....	.....
Idaho.	12	12	9	9	....	....	....	....	....	....	2.90	2.70	2.00	2.55	110	215	....	....	.....	.....
Wash.	12	13	10	10	....	....	....	....	10	....	4.00	3.05	2.00	2.50	85	180	....	....	.....	.....
Oreg..	12	12	11	11	....	....	....	....	14	17	3.00	3.00	2.10	2.20	110	160	....	....	.....	.....
Cal...	11	13	6	8	....	....	....	....	13	16	3.00	2.40	1.60	2.00	85	155	115	175	.....	.....
U.S.	13.5	13.7	10.8	11.1	12.5	12.4	109.8	109.9	12.0	20.5	2.89	2.05	1.38	2.03	95.3	155.2	90.8	87.3	68.42	91.36

TABLE 11.—*Prices paid to producers of farm products, by States*—Concluded.

State.	Prices paid to producers, March 15.						Prices paid by producers, March 15.									
	Clover seed, per bushel.		Timothy seed, per bushel.		Alfalfa seed, per bushel.		Clover seed, per bushel.		Timothy seed, per bushel.		Alfalfa seed, per bushel.		Bran, per ton.		Cotton-seed meal, per ton.	
	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914	1915	1914
	Dolls	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*	*Dolls*
Maine	.....	.....	.....	.....	.....	.....	12.20	9.75	4.30	3.50	.....	.....	31.10	29.60	33.90	35.20
New Hampshire	.....	.....	.....	.....	.....	.....	11.50	11.50	3.90	3.50	.....	.....	30.10	30.50	34.60	35.10
Vermont	.....	.....	.....	.....	.....	.....	11.15	11.00	4.15	3.60	11.35	10.00	29.30	29.40	34.10	34.90
Massachusetts	.....	.....	.....	.....	.....	.....	12.65	.....	4.00	3.12	15.00	.....	29.50	30.50	34.90	35.50
Rhode Island	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29.80	29.60	34.00	36.00
Connecticut	.....	.....	.....	.....	.....	.....	10.00	12.00	3.50	2.80	.....	.....	29.40	29.00	33.80	34.00
New York	10.80	10.80	3.90	3.00	10.50	9.80	11.40	10.50	4.10	3.20	11.10	9.00	30.00	28.80	34.20	34.30
New Jersey	.....	.....	.....	.....	.....	.....	10.50	10.70	3.65	3.20	11.50	9.40	30.00	29.90	33.90	35.50
Pennsylvania	9.30	8.75	3.45	2.60	8.50	7.40	10.20	10.00	3.70	3.05	10.70	9.40	29.10	29.40	34.10	35.20
Delaware	9.00	8.75	3.20	2.82	.....	.....	10.00	10.38	3.75	3.25	8.00	.....	32.30	30.00	.....	.....
Maryland	.....	.....	.....	.....	.....	.....	8.75	9.90	3.50	3.00	.....	.....	29.30	30.20	33.30	35.00
Virginia	10.40	9.55	3.45	3.00	.....	.....	10.50	10.35	3.60	3.10	10.30	9.20	30.20	29.30	31.80	33.90
West Virginia	10.40	10.00	3.25	3.05	.....	.....	10.90	10.45	3.80	3.25	10.90	9.25	31.30	30.80	33.90	35.00
North Carolina	9.40	9.75	.....	.....	.....	.....	11.20	9.60	3.90	3.40	.....	.....	31.60	31.80	30.80	33.20
South Carolina	.....	.....	.....	.....	.....	.....	10.00	.....	.....	.....	11.25	.....	32.00	31.60	29.40	30.40
Georgia	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10.80	.....	33.10	31.60	29.50	30.20
Florida	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33.10	30.70	31.60	32.70
Ohio	8.25	8.10	2.90	2.25	9.00	8.10	9.45	9.20	3.55	2.80	10.30	9.30	29.60	28.60	33.50	34.60
Indiana	8.40	7.80	3.10	2.50	9.45	8.10	9.65	8.80	3.65	2.95	10.60	8.95	28.30	27.80	32.40	34.10
Illinois	9.15	8.55	3.00	2.45	9.70	8.30	10.10	9.95	3.55	2.85	10.50	9.80	26.90	26.50	31.70	32.40
Michigan	8.15	7.80	3.10	2.40	9.25	7.65	9.80	9.60	3.75	3.10	10.90	8.90	29.30	28.80	33.40	34.20
Wisconsin	7.70	7.80	2.70	2.35	9.10	9.75	9.00	8.65	3.40	2.75	10.90	10.00	25.40	26.10	34.30	34.40
Minnesota	8.50	8.70	2.80	2.50	8.80	.....	10.00	11.60	3.40	3.10	12.25	11.70	25.30	24.40	36.00	32.70
Iowa	9.50	8.70	2.80	2.10	9.80	8.40	10.10	9.40	3.00	2.30	11.40	8.70	26.90	25.90	30.90	31.70
Missouri	9.90	9.10	3.20	2.80	9.70	7.70	10.70	9.75	3.80	3.40	10.70	9.00	26.00	25.50	30.20	30.70
North Dakota	.....	.....	2.40	.....	10.50	.....	9.00	10.60	2.65	2.60	11.00	14.00	24.80	21.40	40.00	26.00
South Dakota	8.00	10.50	2.30	2.00	9.00	8.70	9.30	11.30	3.00	2.10	10.20	11.00	25.30	22.90	33.80	31.00
Nebraska	10.00	9.20	3.30	2.45	8.30	6.50	11.00	10.50	3.50	3.40	9.70	7.30	24.80	24.20	32.50	35.40
Kansas	8.80	8.60	2.90	2.75	7.20	5.80	10.50	10.00	3.60	3.00	8.20	6.40	23.40	24.10	30.80	32.10
Kentucky	9.60	9.45	3.50	2.90	9.95	10.00	10.35	10.00	3.75	3.00	10.30	9.00	28.40	29.40	29.90	32.50
Tennessee	10.40	9.20	3.45	2.82	10.30	9.40	11.40	10.10	3.75	3.00	10.90	9.10	29.40	29.30	30.80	31.00
Alabama	.....	.....	.....	.....	.....	.....	12.00	12.50	.....	.....	12.00	.....	32.50	31.90	30.40	30.60
Mississippi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11.90	.....	30.70	31.30	29.50	30.70
Louisiana	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28.60	29.60	30.50	30.40
Texas	.....	.....	.....	.....	7.20	.....	.....	.....	.....	.....	10.70	7.90	30.30	30.40	29.70	31.70
Oklahoma	.....	.....	.....	.....	7.00	6.50	.....	.....	.....	.....	8.50	7.15	27.90	27.00	28.90	31.30
Arkansas	10.70	10.38	.....	.....	.....	.....	11.00	11.30	3.80	3.40	11.10	10.90	28.00	27.50	28.40	29.80
Montana	.....	.....	.....	.....	9.00	8.20	11.00	12.50	3.50	3.00	11.00	10.00	27.60	22.60	27.60	.....
Wyoming	.....	.....	2.80	2.50	7.45	7.40	10.00	.....	3.20	3.15	9.00	9.50	27.50	24.40	.....	.....
Colorado	.....	.....	2.25	.....	9.60	7.00	.....	.....	.....	.....	9.85	7.90	27.70	26.60	32.20	35.40
New Mexico	.....	.....	.....	.....	7.20	8.00	.....	.....	.....	.....	8.00	12.50	31.80	31.10	34.70	38.00
Arizona	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	46.00	32.00	.....	.....
Utah	.....	.....	4.00	5.00	7.50	6.25	10.00	11.00	5.00	3.60	8.30	7.00	27.00	24.20	.....	.....
Nevada	.....	.....	.....	.....	7.30	8.00	.....	.....	.....	.....	.....	.....	35.00	33.50	.....	.....
Idaho	7.90	6.90	2.25	1.75	8.00	6.50	10.00	9.40	3.60	2.75	10.40	8.70	27.90	23.00	.....	.....
Washington	.....	.....	.....	.....	.....	.....	12.50	11.00	4.05	4.20	13.00	12.00	30.30	24.50	38.00	39.20
Oregon	8.00	7.40	.....	.....	9.60	7.00	.....	.....	3.30	2.70	11.00	8.20	28.00	23.80	.....	.....
California	.....	.....	.....	.....	8.10	7.30	13.80	12.00	4.50	4.05	10.50	8.30	31.90	29.10	30.00	.....
United States	8.55	8.17	2.78	2.30	7.92	6.60	10.33	9.45	3.60	2.97	9.58	8.01	28.23	27.58	31.32	32.65

TABLE 12.—*Averages for the United States of prices paid to producers of farm products.*

Product.	March 15.					April 15.		February 15.		
	1915	1914	1913	1912	1911	1914	1913	1915	1914	1913
Hogs.....per 100 pounds..	$6.33	$7.80	$7.62	$5.94	$6.74	$7.80	$7.94	$6.34	$7.75	$7.17
Beef cattle.....do....	5.92	6.28	5.88	4.75	4.66	6.29	6.00	5.93	6.16	5.55
Veal calves.....do....	7.50	7.92	7.49	6.11	6.48	7.68	7.38	7.62	7.90	7.23
Sheep.....do....	5.36	4.77	4.97	4.12	4.45	4.96	5.16	5.14	4.67	4.63
Lambs.....do....	6.06	6.31	6.56	5.38	5.49	6.47	6.59	6.67	6.18	6.34
Milch cows.....per head..	58.00	59.23	54.02	44.09	45.42	59.60	55.34	57.99	59.09	51.42
Horses.....do....	132.00	138.00	146.00	140.00	145.00	138.00	148.00	132.00	139.00	146.00
Chickens.....per pound..	.117	.124	.115	.....	.....	.130	.121	.113	.120	.112
Eggs.....per dozen..	.165	.222	.170	.....	.....	.164	.159	.237	.253	.213
Honey, comb.....per pound..	.135	.137	.139	.139	.135	.137	.141	.137	.137	.139
Honey, extracted.....do....	.108	.111	.119	.127	.121	.110	.125	.110	.114	.123
Maple sugar.....do....	.125	.124	.126	.111	.....	.125	.130	.116	.....	.122
Maple sirup.....per gallon..	1.10	1.10	1.06	1.05	.....	1.10	1.10	1.06	.....	1.06
Wool, unwashed...per pound..	.228	.164	.184	.169	.168	.168	.177	.202	.157	.187
Peanuts.....do....	.042	.047	.047	.050	.048	.049	.048	.044	.047	.045
Apples.....per bushel..	.73	1.29	.82	1.04	1.25	1.37	.85	.73	1.23	.78
Beans.....do....	2.89	2.05	2.10	2.42	2.17	2.11	2.11	3.02	2.09	2.19
Sweet potatoes.....do....	.91	.87	.91	1.02	.87	.92	.94	.85	.86	.87
Onions.....do....	.95	1.55	.77	1.67	1.05	1.60	.79	.98	1.41	.78
Cabbages.....per 100 pounds..	1.38	2.03	1.03	2.88	1.26	2.24	1.15	1.41	2.07	1.17
Timothy hay.....per ton..	14.28	.....	.....	.....	.....	.....	.....	14.28	.....	.....
Clover hay.....do....	13.41	.....	.....	.....	.....	.....	.....	13.36	.....	.....
Alfalfa hay.....do....	9.79	.....	.....	.....	.....	.....	.....	9.32	.....	.....
Prairie hay.....do....	8.03	.....	.....	.....	.....	.....	.....	7.86	.....	.....
Clover seed.....per bushel..	8.55	8.17	10.42	12.89	8.56	8.06	11.00	8.60	8.07	10.28
Timothy seed.....do....	2.78	2.30	1.72	7.33	4.93	2.28	1.74	2.66	2.12	1.78
Alfalfa seed.....do....	7.92	6.60	8.19	.....	.....	6.77	8.36	7.86	6.48	8.15
Broom corn.....per ton..	68.00	91.00	57.00	99.00	78.00	89.00	58.00	78.00	95.00	56.00
Cotton seed.....do....	22.32	23.60	21.55	18.21	25.49	24.17	21.89	23.33	23.37	22.01
Hops.....per pound..	.120	.205	.....	.401	.192	.206	.150	.111	.191	.169
Paid by farmers:										
Clover seed...per bushel..	10.33	9.45	12.30	.....	.....	9.84	12.90	10.32	9.77	11.62
Timothy seed.....do....	3.60	2.97	2.33	.....	.....	2.95	2.43	3.56	2.94	2.47
Alfalfa seed.....do....	9.58	8.01	9.78	.....	.....	8.17	9.99	9.29	7.98	9.60
Bran.....per ton..	28.23	27.58	24.96	29.16	24.94	28.50	24.69	28.96	26.91	25.32
Cottonseed meal....do....	31.32	32.65	31.08	31.22	31.32	32.75	30.89	30.88	32.59	31.16

Product.	April 1.					May 1.		March 1.		
	1915	1914	1913	1912	1911	1914	1913	1915	1914	1913
Wheat.....cents per bushel..	131.7	84.2	79.1	92.5	83.8	83.9	80.9	133.6	83.1	80.6
Corn.....do....	75.1	70.7	53.7	71.1	49.7	72.1	56.8	75.1	69.1	52.2
Oats.....do....	53.4	39.5	33.1	52.0	32.3	39.5	34.2	52.1	38.9	33.1
Barley.....do....	64.7	51.7	48.5	92.3	69.1	49.3	48.3	67.7	51.1	49.0
Rye.....do....	100.4	63.0	62.9	85.1	75.4	62.9	62.4	105.4	61.9	63.2
Buckwheat.....do....	85.3	76.9	68.3	76.9	65.3	77.3	71.4	85.5	75.1	67.0
Potatoes.....do....	47.8	70.0	50.3	117.1	55.5	71.4	48.2	50.4	70.7	52.0
Flaxseed.....do....	167.7	132.8	113.6	191.3	234.6	134.7	114.3	157.9	132.5	119.0
Hay.....dollars per ton..	11.64	12.20	11.15	16.79	11.89	12.32	11.13	11.71	12.37	11.34
Butter.....cents per pound..	25.8	24.9	27.6	26.1	22.6	23.8	27.0	26.8	26.0	27.5
Eggs.....cents per dozen..	16.6	17.6	16.4	17.8	14.9	16.8	16.1	21.3	24.2	19.4
Chickens.....cents per pound..	11.9	12.3	11.6	10.8	10.8	12.5	11.8	11.7	12.1	11.1
Cotton.....do....	8.1	11.9	11.8	10.1	13.9	12.2	11.6	7.4	12.6	11.8

TABLE 13.—*Range of prices of agricultural products at market centers: Statement for April, 1915.*

Product and market.	April 1, 1915.	March, 1915.	February, 1915.	March, 1914.	March, 1913.
Wheat per bushel:					
No. 2 red winter, St. Louis	$1.49 –$1.49	$1.36½–$1.57½	$1.45 –$1.64	$0.92 –$0.96½	$0.97½–$1.12
No. 2 red winter, Chicago	1.51 – 1.52	1.36½– 1.62½	1.45½– 1.68	.92½– .96½	1.01 – 1.08
No. 2 red winter, New York [1]	1.63 – 1.64½	1.49½– 1.74	1.58 – 1.80	1.05 – 1.06	1.09½– 1.12
Corn per bushel:					
No. 2 mixed, St. Louis	.74½– .74½	.70 – .75½	.68½– .78	.65 – .72	.49 – .54½
No. 2, Chicago	.72 – .73½	.70 – .75	.68½– .78	.63 – .70	.50 – .53½
No. 2 mixed, New York [1]	.79 – .80	.76¼– .82	.75½– .88½	.68⅝– .72½	.55½– .58½
Oats per bushel:					
No. 2, St. Louis	.57½– .57½	.55 – .60	.55 – .60	.38½– .43	.32 – .34
No. 2, Chicago	.56½– .56¼	.53⅜– .60⅛	.53 – .60	.37½– .39¼	.31⅛– .33½
Rye per bushel: No. 2, Chicago	1.16 – 1.17	1.12 – 1.21	1.15 – 1.31	.59½– .63	.58 – .62½
Baled hay per ton: No. 1 timothy, Chicago	14.50 –15.50	14.50 –16.00	15.00 –16.00	14.50 –16.00	13.00 –16.50
Hops, per pound: Choice, New York				.42 – .45	.21 – .27
Wool per pound:					
Ohio fine unwashed, Boston	.28 – .29	.28 – .29	.24 – .29	.22 – .22	.23 – .24
Best tub washed, St. Louis	.40 – .40	.40 – .40	.30 – .35	.28 – .29	.33 – .35
Live hogs per 100 pounds: Bulk of sales, Chicago	6.75 – 6.85	6.50 – 6.95	6.35 – 7.00	8.20 – 9.00	8.75 – 9.50
Butter per pound:					
Creamery, extra, New York	.30½– .30½	.28½– .32	.24 – .30	.24½– .32	.35½– .42
Creamery, extra, Elgin	.28½– .28½	.28½– .29	.29 – .32	.25 – .30	.34 – .35
Eggs per dozen:					
Average best fresh, New York	.19½– .20½	.18½– .20½	.33 – .40	.21 – .36	.20 – .31
Average best fresh, St. Louis	.18½– .18½	.17 – .18½	.20 – .28	.17½– .27	.16 – .19
Cheese per pound: Colored,[2] New York	.16¼– .17	.16 – .17¼	.16½– .17½	.16½– .17½	.16 – .17¼

[1] F. o. b. afloat.
[2] September colored—September to April, inclusive; new colored May to July, inclusive; colored August.

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IRRIGATION PRACTICE IN RICE GROWING.

By C. G. HASKELL, *Irrigation Engineer.*

INTRODUCTION.

Irrigation is a necessity in profitable rice culture, except in favored localities whose seasonal rainfall is very high. In general, therefore, a plentiful and easily accessible water supply is the first requisite where rice is to be grown, and the proper utilization of this supply in irrigating the crop is a matter of much importance to the rice grower. It is the purpose of this bulletin to discuss methods and means of irrigation as developed in the rice fields of the United States.

Rice thrives best in a warm, humid climate. A growing season of at least 135 days and a rich loam or clay soil level enough to permit economical irrigation, underlain by a tight formation through which water will not percolate readily, are other conditions only second in importance to the water supply, if the crop is to be produced on a profitable scale. These combined conditions are found in various sections along the South Atlantic coast, on the prairies of southwestern Louisiana, southeastern Texas, eastern Arkansas, and the alluvial lands along the Mississippi River and its tributaries in those States and in Mississippi.

Almost the whole of the present rice crop of the United States is grown in the sections named, although rice fields now being developed in the Sacramento Valley of California may soon add a considerable area to the acreage devoted to this crop. For many years the Carolina rice fields produced nearly all of the rice grown in the United States, but the Civil War greatly injured the industry, and in recent years many of the Carolina farmers have found their crop unable to compete with rice grown on new lands farther west by cheaper methods. By far the larger part of the rice crop of the United States is now produced on the prairie lands of Louisiana, Texas, and Arkansas.

NOTE.—This bulletin will be of interest to farmers growing rice under irrigation.

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MAKING A WATER SUPPLY AVAILABLE.

Most of the rice land in the South Atlantic States lies along tide-water streams. It is very level, and at high tide is subject to overflow. To control this, levees are built along the river fronts and back to the high land, holding off the river water during high tide. Inside levees divide the fields into rectangular-shaped cuts, approximately 40 acres each in area. The water is brought to the field through a canal with branches extending to each cut. A small box, locally called a trunk, with a gate at either end, is placed under the levee where the branch enters, to regulate the flow of water to and from the field. A ditch about 4 feet wide and 4 feet deep extends from the trunk parallel to the levee which surrounds each cut and about 20 feet from it, around the inside of each cut and back to the trunk. Other narrower ditches extend in from the main ditch on opposite sides until only enough open space remains for a team to pass between their ends. This system of ditches permits the water to flow quickly to or from the cuts when the gates of the trunks are properly set, according to the height of the tide.

Much of the rice land along the Mississippi also is protected from the river's overflow by levees, since it is lower than the level of the water at certain stages of the river's flow. At such times water for irrigation is lifted from the river and over the levees by means of siphons. When the river is low the water must be pumped into reservoirs built inside the levee and enough higher than the field to cause the water to flow through the siphon and so over the levee. Small portable pumping plants are used for this purpose. During the seasons when the river is high the expense of obtaining water is low, but when the river is low the cost of irrigation becomes much heavier on account of the expense of pumping.

The fields along the lower Mississippi slope back to the swamp or low land. Parallel drain ditches are dug down this slope at distances apart varying from 200 to 600 feet. Levees are built along the sides of the ditches and cross levees to meet them at right angles, one for every drop of 0.2 to 0.5 foot in the slope of the land. The cross levees thus come 50 to 800 feet apart and form rectangular cuts of varying sizes. The water is allowed to flow from cut to cut across the field, and at the proper time is drained off through the ditches.

Rice growing has been somewhat stimulated in the upper part of the river country in recent years by the advance of the boll weevil into that section, and much land formerly devoted to the cultivation of cotton has been put into rice. In this section methods of irrigation are similar to those practiced on the prairie lands of Arkansas, southeastern Texas, and southwestern Louisiana. There a water supply is secured by pumping from rivers, lakes, and bayous, and from wells,

the latter permitting the irrigation of large areas not accessible to canals.

The industry is new in California, but promises to become of much importance in certain sections of that State, especially in the Sacramento Valley, where water is secured for irrigation by gravity flow or by pumping from streams.

PUMPING.

In the three principal rice-growing States—Louisiana, Texas, and Arkansas—all but 2.5 per cent of the irrigated land in rice is supplied with water by pumping, and wells afford a supply for about one-third of this area. These wells and their pumping equipment are usually owned by the individual farmers, and in all about one-half the rice acreage is now irrigated by means of works owned or controlled by the water users. The remainder of the rice land is irrigated with water obtained from large canals owned by companies or individuals, who furnish it to the rice growers on a rental basis.

The pumping plants vary in size and capacity according to the area to be irrigated and the height to which the water must be elevated. For prairie lands the machinery is generally designed to provide 7½ gallons, or 1 cubic foot, of water per minute for each acre irrigated. For the alluvial lands along the streams 10 gallons of water per minute per acre or more should be provided, and if the soil is a loose, sandy loam, with a porous subsoil, and is located near a river or lake, 38 to 40 gallons per minute per acre sometimes is required. If the water is not carried far and is economically applied to the fields, a smaller amount will be sufficient. It is not good policy to estimate too closely in designing a plant, and some plants now operating are capable of delivering much more water than is usually needed. The height to which water is elevated varies from 10 to 80 feet.

Some of the largest and best-equipped pumping plants in the world are located along the streams of southwestern Louisiana and southeastern Texas for use in rice irrigation. They are frequently equipped with one or more large horizontal centrifugal or rotary pumps operated by compound condensing Corliss engines. Steam is generally supplied from horizontal water-tube boilers, and petroleum is often used as fuel. A saving of about 10 per cent of the fuel is effected by the use of feed-water heaters. Among earlier pumping plants to be installed were many which delivered large quantities of water but were expensive to operate. High cost of operation was not then considered serious by many irrigators, but during recent years many improvements have been made in the design of plants which have appreciably lowered the expense of pumping. Petroleum

has been found to be the best fuel within short distances of the oil fields and most of the pumping plants in these sections use it. When wood and coal are plentiful and cheap they are used, especially for small outfits. In other locations gasoline and kerosene are used.

CANALS.

The canals which carry the water to the rice fields consist merely of two parallel levees built upon the surface of the ground 50 to 200 feet apart. Ordinarily the canals are given but little fall and the slow velocity at which the water flows results in almost no loss of head and keeps down the total lift at the pumping plant. This plan is essential, for the cost of pumping depends largely upon the height to which the water must be elevated. Laterals or smaller canals branch out from the main canal to reach land in each direction. Still smaller laterals distribute the water to the fields.

One of the chief items of cost in rice growing is the irrigation water. This varies with the height to which the water is pumped, the amount of water used, the cost of the fuel and attendance for the pumping plant, and the first cost and efficiency of the plant itself. A considerable saving can sometimes be made by several congenial farmers uniting in the establishment of one large plant for their common use, where numerous small individual outfits would otherwise be necessary. A saving in the first cost of machinery, in buying and handling fuel, repairs, and wages of engineers and firemen will thus be possible. One main canal of generous capacity will then answer the purpose of several smaller ones.

WELLS.

The development of wells has permitted the irrigation of much land that otherwise would not be planted to rice. Wells capable of supplying water for rice irrigation can be sunk in nearly all parts of the rice country. The whole of this section is underlain with strata of unconsolidated materials, clay, sand, and gravel, deposited when the region was part of the floor of the Gulf of Mexico, and water is pumped from the sand and gravel beds. In some localities several strata of water-bearing materials are found, but in a few places these are so thin and are composed of such fine sand that but little water can be secured from them. Abundant supplies of water are usually to be found, however.

Pumping from wells is, as a rule, slightly more expensive than pumping from streams on account of the increased lift, but when the rainfall is abundant and favorably distributed not so much pumping is necessary, and well owners have an advantage over irrigators dependent on canal water, which must be paid for, whether much water

is used or not. During dry seasons, however, farmers on canals who get all the water they need have the advantage, because then the wells have to be pumped much of the time. In some wells along the Gulf coast the water stands near the surface of the ground or overflows. Back from the coast the ground surface is sometimes 35 or 40 feet above the water level. In Arkansas the depth of the water level varies from 25 to 60 feet.

POSSIBILITIES IN OTHER METHODS OF OBTAINING WATER.

So-called "providence" methods of growing rice are not usually to be depended upon, but nature will frequently supply part or all of the water needed at small expense. Natural precipitation should not be expected to deliver all of the water needed. However, lest the profits from one crop be offset by losses as large the following year, a reliable water supply should be available for irrigation should the rainfall prove insufficient. The necessity for pumping may often be relieved by planting the rice in low places where water will flow in from surrounding higher land during rains, by storing rain water in reservoirs on higher land, from which it may be allowed to flow down as needed, or by damming up and diverting to the field a small natural stream or water flowing in roadside ditches after rains or when other rice fields are being drained. The extension of field levees out over surrounding land to divert the rainfall to the field; the pumping of water to rice on higher land from a reservoir built in a low place; or even the planting of rice on land that is under water all or nearly all the time, or where water is backed up by tides or overflowed from the swamps and streams, often will serve the same purpose. These methods, which generally can be most easily practiced in thinly settled localities where the irrigation works will not interfere with the operations of neighboring farmers, will very often reduce the amount of water which must be pumped, and consequently will lower the cost of irrigation.

PREPARING FOR IRRIGATION.

After a reliable supply of water has been secured a lateral or small canal must be built to convey the water to the field. A lateral consists of two parallel levees built as high as necessary and 10 to 50 feet apart, depending upon the amount of water required to irrigate the farm. The water must be brought to the highest point of the field. It is most easily distributed if the lateral extends part way down the side of the field past the ends of most of the cuts so that the water may be applied to any cut desired. If the cuts are very long, the lateral should be extended down the slope across the cuts through the center of the field. In this way the water can be applied to the land

most easily. If the source of water is near the field, little or no lateral construction will be necessary.

A large field levee 12 inches or more in height is built around the field to prevent the escape of water. Other levees are built on the field following its contours, to hold the water on the land, a levee being built for every drop of 0.2, 0.3, or 0.4 foot as seems advisable. The field is thus divided into irregularly shaped cuts, depending in size and shape upon the slope of the ground, each cut inclosing a plat of nearly level ground.

An old form of field levee having a base about 5 feet wide and side slopes of 2 horizontal to 1 vertical is quite generally used, although these high, narrow levees act as a barrier to the passage of farm machinery and necessitate the separate cultivation of each cut. They often are covered with unsightly growths of weeds and grass.

Numerous advantages favor wide levees built on bases at least 10 feet wide, and with side slopes gentle enough so that teams can work over and rice be grown on them. These are not much more expensive to build, but do away with much of the annoyance of weeds and grass, and allow the field work to be done much more easily. During harvest they offer dry places on which much of the rice can be shocked. Wide levees are most frequently found on fields which have been brought under cultivation during late years, notably in Arkansas, although some are to be found along the Gulf coast.

LOCATION OF FIELD LEVEES.

Much care is necessary in the location of field levees, since their careless placing is liable to result in uneven flooding when irrigation is begun. Levees usually are permanent, hence their correct location at the start will obviate much trouble and expense so long as the field is irrigated. Only a competent surveyor or a farmer with some experience in using an engineer's level should be engaged to lay out the levees, and he should be given plenty of time to do the work properly. The surveyor will need an assistant to carry the rod. This helper should be a rapid walker and have good judgment in estimating the lay of the land. Level readings at points short distances apart will be necessary so that needless crookedness in the levees may be avoided.

In a large field where the surveyor has to change the position of his instrument to avoid errors, he should establish a system of stakes so that at least one of them will be within reading distance from any part of the field. Levels should be taken on all the stakes to secure the relative elevation of each and should be checked back to the starting point. The level itself should be in good adjustment and sights over 800 feet long should be avoided. The form of the levee and the drop

to be given having been decided upon, the rodman should be sent to the highest part of the field for several readings to show the average elevation of the land. The target should be set on a level with the horizontal wire of the instrument, then raised as high as the drop between the levees is to be, and clamped into place. The rodman then goes to lower ground, holding the rod on the ground frequently so that the surveyor may take readings until the horizontal wire again intersects the target. He then goes over the field giving frequent readings, say every 30 paces, until the points of equal elevation are found. When the surveyor is taking a reading, the rodman should hold the rod in a vertical position. He should choose a point on which to hold the rod the elevation of which is as near as possible to the mean elevation of the ground near which he stands.

A team and plow (preferably a riding plow) should follow the rodman to mark the position of the levee as soon as it is located. Much time can be saved by using another helper to occupy the last point located until the team reaches that point. A boy may be used for this work. This enables the rodman to move on as soon as a point is located. In building levees on a field the furrows must be followed carefully. If the turns are very short or the furrows zigzag, they may be straightened, but a gradual curve should be followed absolutely. Often the improper location of levees is due to the farmer's neglect to follow the furrows, rather than to mistakes on the part of the surveyor.

Field levees should make no sharp turns unless the ground is very uneven, and should be as nearly parallel as possible. Unless the ground makes a drop too steep to permit irrigation or an obstruction interferes, two contour levees should never meet.

BUILDING FIELD LEVEES.

New field levees should be built and all old field levees should be reworked in the winter, when work is slack and the soil is wet. At that time the necessary care may be given to their construction and the levees will be more compact than those made in the late spring or early summer, on account of the winter rains. Levees built in the winter have the further advantage of longer time in which to settle before being used.

In building field levees the ground should be plowed and disked, so that a proper union of the old and new dirt may be brought about by the time the levee is completed. Any large plow may be used. Three or four rounds are plowed, depending upon the size of the plow, the earth being thrown to the levee from both sides. If a large disk plow is used and the team is driven at a fast walk for the last

round or two, the earth can be thrown well toward the center of the levee. A rolling coulter should be used with the moldboard plows, because it leaves a square bank, against which the "push" can slide without leaving the furrow. After the center of the levee has been built by plowing, additional furrows are plowed and shoved on the top and sides of the first ones with a wooden "push," until enough dirt has been heaped up to make the levee the desired size and shape.

A "push" (fig. 1) consists of two heavy planks set on edge with one set of ends spiked together and the other ends spread out so as to form a figure "A" when the braces are in place. Sometimes the parts where the friction is the greatest are faced with metal. They are made of various sizes and shapes, depending upon the size of the levee to be made and the strength of the team, but should be long enough to move the dirt easily and wide enough at the rear to push it as far as is required.

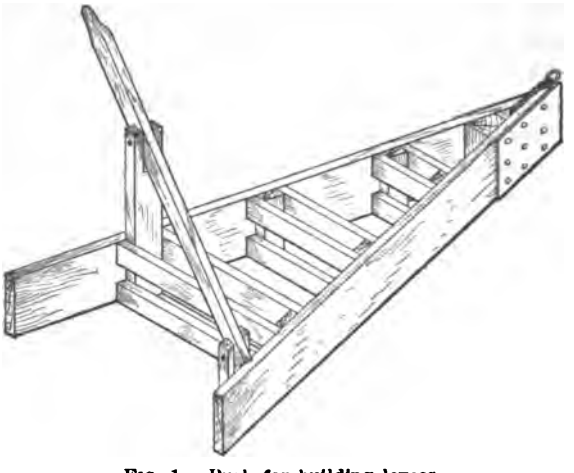

FIG. 1.—Push for building levees.

One side may be made shorter than the other, the shorter side being used to push the earth when it is to be moved a short distance and the long side when the desired distance is greater. A lever with one end fastened to the rear end of the levee side of the push and its center supported from the land side in a horizontal position, crosswise to the furrow, is used to regulate the amount of earth handled and to keep the push in place. In case the push is to be used to shove dirt with either side this horizontal regulating lever must be made so that it may be changed from one side to the other. Sometimes a vertical lever, 5 feet long, used to regulate the push, is fastened to the rear cross braces. A chain passes from a large clevis in the sharp end, or top of the "A," to the team. Sometimes it passes through the clevis and is bolted to the sides of the push. The clevis should be placed just high enough in the heavy wedge of timber generally spiked in the sharp angle formed by the sides of the push, and the chain should be of such length as to cause the sharp end of the push to just drag in the bottom of the furrow and not be lifted into the air.

The sides of some pushes are not vertical, but slope from top to bottom at an angle of 1 horizontal to 3 vertical. When the levee side of the push is elevated on the levee the two sides will be vertical. The land side thus runs straight up in the furrow and not on a slope. The side thrust of the dirt which is being moved prevents the push from leaving the furrow easily. The levee side of the push stands vertical and does not cut under and carry a mass of earth along with it, but allows the earth to roll ahead and slide up the slope. Some pushes are made with a hinge at the front, and the braces are properly adjusted so that the two sides may be swung from or toward each other as desired, being then held in place by pins passing through one of a series of holes in the braces. The horizontal regulating lever for this push is fastened to the rear end of the levee side, but just slides in a notch on the land side so that it does not interfere with the adjustment of the width. The chief advantage which this push possesses is that it may be adjusted to handle dirt at different distances from the levee. Pushes are frequently made with the sides 12 and 13 feet long and 4½ feet wide.

USING A PUSH.

When the push is in use the team is driven along the side of the levee so that the sharp end of the implement follows the last furrow plowed. One side slides in this furrow while the other crowds the loose earth up the levee. Eight mules, with two drivers and a man to tend the push, generally are required to do good work, although smaller pushes, requiring fewer animals, are used when mules are scarce.

When possible, the teams should be worked abreast. In this way the distance back to the push is shortened, one team does not interfere with the other, and there is less tendency for the push to cut out of the furrow when going around a bend. The evener used should be long enough and strong enough so that four large mules may work on each end, the animals in each team then being driven abreast and unattached to the other four. When the push is about to run out of the furrow a swinging of either half or all of the 8-mule team the other way will keep it in place. The man who regulates the push presses down or lifts up the lever, as the push takes too much or too little dirt. This process of plowing and pushing the dirt into the levee is continued until an embankment of the proper shape and size is secured. If several furrows are plowed and pushed in to fill the ditches from which the dirt was removed to build the levee, berms may be built on the side of the levee and the ditches be made shallow and moved from the levee. This will make the side slopes much more gradual and will enable teams to work over the levees. Field levees

should be built at least one-third higher than the level of the water they are to hold, thus permitting rain water to be held on the field and allowing for washing, settling, and for irregularities in the levees. Levees usually appear higher than they really are, and it is well to build them up 12 inches or higher. A farmer may not be able to complete the building of the wide form of levees on his field the first year, but in that case he should aim to widen his levees each year until the proper shape is secured.

Water should not be held deep on the upper side of the levee until the latter has had time enough to thoroughly settle or to gradually become soaked. In sections where the hardpan is some distance below the surface, or where there is no hardpan at all, but merely a closely formed clay, which, when wet, will not support animals, levees have to be built when the ground is dry.

Field levees should be made of good size. The cost of maintaining poor levees is high because they wear down quite rapidly. Poorly constructed levees permit considerable loss of water. It is cheaper to put dirt in a levee with a team and machine before flooding time than with a shovel after the ground is covered with water.

Field levees often are built with a levee plow or with an ordinary road grader. Sometimes only a large disk plow is used. The levee plow is made in various sizes and shapes and consists of a large, strong plow with a long, extended land side and a long steel scraper board, one end of which is welded or fastened by a bolt to the end of the moldboard of the plow. The scraper board is held in position by strong braces, and if the board is fastened by a bolt, the braces are made adjustable, allowing the board to be so regulated that the dirt is moved from 2½ to 6 feet and piled 1½ feet high or more, depending upon the size of the machine.

COST OF FIELD LEVEES.

The cost of building field levees varies with different kinds of soil, the cost of labor, and the number, shape, and size of the levees. The cost of the surveying is variable, depending upon conditions. Fifty or sixty cents an acre is considered the maximum, and 20 cents will sometimes be enough. In one instance, narrow levees were built on 500 acres of river land where the soil was easily worked and the levees were long and close together. The cost per acre was $1.15, or 50 cents for surveying and 65 cents for pushing the levees. The cost of building levees varies from 20 cents per acre, when the land is level and only a few small levees are needed, to $2.50 per acre, where many high levees are built. The yearly cost of repairing levees varies from 5 to 50 cents per acre. Large, high levees cost $12 to $25 per mile. On an average the cost of field levees and the laterals is about $1.50 per acre.

GATES.

On heavy clay soils there is no need of measures to prevent the washing of large openings in the lateral or field levees, but on loose, sandy, loam soils these are necessary. A board set deep edgewise in the levee where the water is to be admitted, so as to permit the water to flow over it, often serves the purpose. Sometimes a sack placed in the opening will keep the dirt from washing out. A wooden gate consists of a floor and end pieces to hold a sliding shutter which regulates the flow of water. The shutter should be made of loose pieces of 4-inch flooring which can be added to or removed as the water is raised or lowered. Such gates make the handling of water much easier than is the case when the levee must be broken each time that the field needs irrigation.

All gates or openings in the field levees should be placed in the corners made by the intersection of the cross field levees with the outside levees, so that they may be out of the way of teams working on the field. The gates should be set deep in the levees, so that all the water may drain from the ditches, and should be in place early in the season, so that the earth may have time to settle around them before irrigation begins, thus preventing many leaks.

APPLYING THE WATER.

The beneficial effects of fresh water on growing rice are evident in the superior appearance of the rice plants where water first enters a field, and by the large yields frequently secured from the cuts first irrigated. The cost of pumping usually is too high to justify frequent drainage and the application of fresh water to the land, but some of the desirable results which follow irrigation with fresh water may be obtained by causing the water to flow in at one end of a cut and out at the other, thus flowing the whole length of each cut. By this circulation fresh water is brought up to the plants and a more even temperature is kept, scum, vegetable matter, and insects also being done away with to a considerable degree. The stale water will thus be pushed down to the low side of the field where it will be the first to escape when the field is drained or overflows during rains.

In the Atlantic coast fields rice is generally planted in rows 15 inches apart, so that it can be cultivated. As soon as the seed is planted the field is generally flooded to cause sprouting, this being called the "sprout" flooding. The water is allowed to remain on the land 6 to 12 inches deep until little white sprouts one-third inch long have pushed through their hulls. The water is then completely drained from the soil in order that the rice may not rot. As soon as the small, sharp-pointed, single leaves of the rice plants appear, the field is given the second flooding. This is called the "point" or

"stretch" flow, its purpose being to force the growth of the rice plants ahead of the weeds and grass and to kill the latter.

After the rice is 6 inches tall the water is generally lowered until it is about 4 inches deep on the land, and is held at that depth 13 to 30 days. The old water is drained off and fresh water is applied every week or ten days. The "stretch" flow is followed by a period of dry growth which lasts 40 to 50 days, during which a short flooding is sometimes applied in dry seasons. At this stage the rice is cultivated with horse plows two or three times and is hoed once or twice by hand to kill all weeds, grass, and red rice, and to stir the soil thoroughly. When the plants have begun to joint the "harvest" flow is applied. The field is flooded 4 or 5 inches deep and the water is allowed to remain until just before the rice is harvested. The rice is cut by hand with sickles, shocked, and thrashed with improved machines.

The average length of the irrigation season in the rice sections of Arkansas, Louisiana, and Texas, extending from the time of the first application of water until it is removed to permit harvest, is about 86 days. Under favorable weather conditions the season may be reduced to 70 days, but early rice, which matures much more slowly than that planted later, may require as many as 120 days of irrigation. In a general way the times of irrigation and the amount of water to be applied depend wholly upon the various stages of the growth of the rice plants, but a number of other factors must also be considered, and these may materially modify the usual irrigation program. Methods of cultivation of rice have been described in other publications of this department, and these should be consulted for information regarding the several periods of development experienced by the rice plant and its demands for water while growth is being made.

Similarly, the judicious and timely application or removal of irrigation water may be made a most effective means of warfare against numerous diseases peculiar to the rice plant and against the insects[1] and other pests which harass it.

[1] Considerable injury is done to the rice plants by a small white worm about one-fourth to one-half inch long. This is called the rice root maggot and is the larva of the rice water weevil. A discussion of the habits of this insect and of its control by irrigation will be found in U. S. Dept. Agr., Bu. Ent. Cir. 152.

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Contribution from the Bureau of Entomology, L. O. Howard, Chief.

CONTROL OF THE CITRUS THRIPS IN CALIFORNIA AND ARIZONA.

By J. R. HORTON, *Scientific Assistant, Tropical and Subtropical Fruit Insect Investigations.*

INTRODUCTION.

The citrus thrips,[1] a minute orange-yellow insect, has in the past few years caused extensive damage to citrus fruits in the San Joaquin Valley of California and also occasioned considerable injury in southern California and Arizona orange groves.

The nature and extent of the injury caused by this insect and its life history and habits were carefully studied, and extensive experiments for its control were conducted by the writer during the period from 1910 to 1912. It is the purpose of the present paper to give briefly the practical control measures resulting from these studies.

INJURY.

The citrus thrips is a sucking insect feeding on the plant juices of the leaves, the fruit rind, and the bark of tender stems, in much the same manner as the mosquito draws its food from its victims. For this reason the insect can not be killed by stomach poisons sprayed on the plant, but must be controlled by sprays that kill by contact.

The injury caused by the citrus thrips begins with the seedling orange tree. The leaves are scarred and distorted, and to a certain extent the stock is devitalized. When the seed stock is budded and the foliage of the seedling trimmed off, the thrips attacks the bud. Nursery buds will make a fine, luxuriant growth of 2 or 3 feet in a

[1] (*Euthrips*) *Scirtothrips citri* Moulton; order Thysanoptera, family Thripidæ.

NOTE.—This bulletin is of interest to the citrus growers of the Pacific coast and the Southwest.

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season if properly sprayed to protect them from thrips. On the other hand, many nursery trees have the leaves and stems so badly scarred and twisted as to give them a blighted, unsightly appearance, and are so retarded in growth that they must be held in the nursery for a year or more beyond the proper time for sale in order to meet the size requirements, thus decreasing the nurseryman's profit by the cost of the extra care. It sometimes happens that this class of stock is sold along with better trees, and the thrips injury continues for

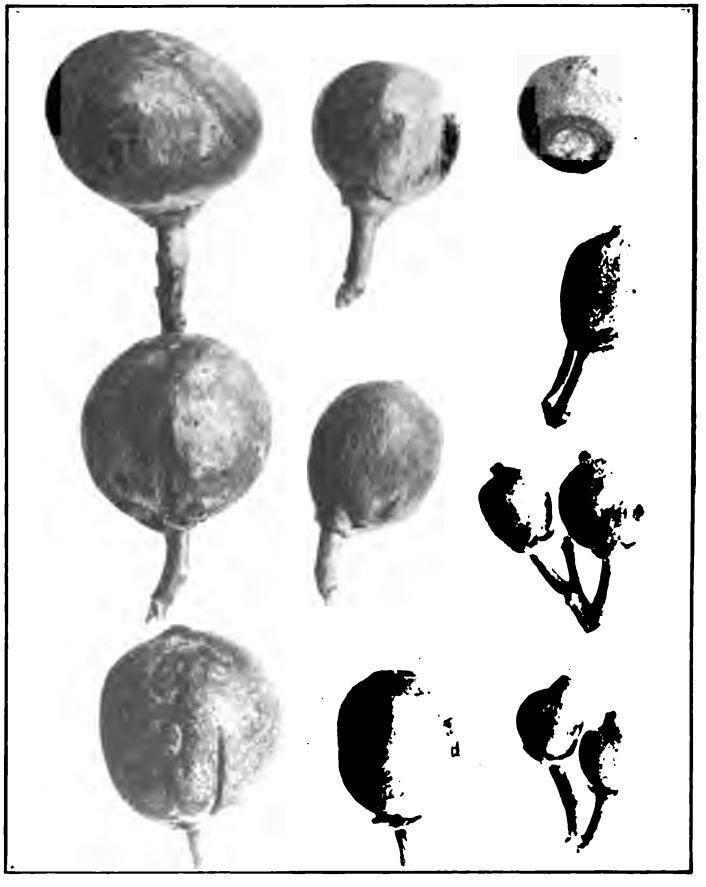

FIG. 1.—Injury to young oranges by the citrus thrips (*Scirtothrips citri*). (Original.)

several years in the orchard. The writer knows of 5-year-old and 7-year-old groves in the foothills of Tulare County which have been held back, principally by thrips, to such an extent that the trees are no larger than 3 and 5 year trees in less infested situations. From the general appearance of such trees it seems evident that they will never attain the size and bearing capacity of trees which have escaped severe thrips infestation in the nursery and during their early years in the orchard.

As the young fruit appears it in turn is attacked (fig. 1), and its market value at maturity is much reduced by the enlarged feeding scars and scabbing (fig. 2). A larger percentage of small-sized fruits than ordinarily develop results, and there is a total loss, as the result of early and severe scabbing, of a proportion of the fruit. To calculate the damage caused by the insect in reducing the grade of the fruit, it is necessary to know the system of grading and the relative market value of the grades. Three packs are usually made in California packing houses at the time of this writing, these packs or grades being variously designated as "Fancy," "Choice," and "Standard"; "Extra Fancy,"

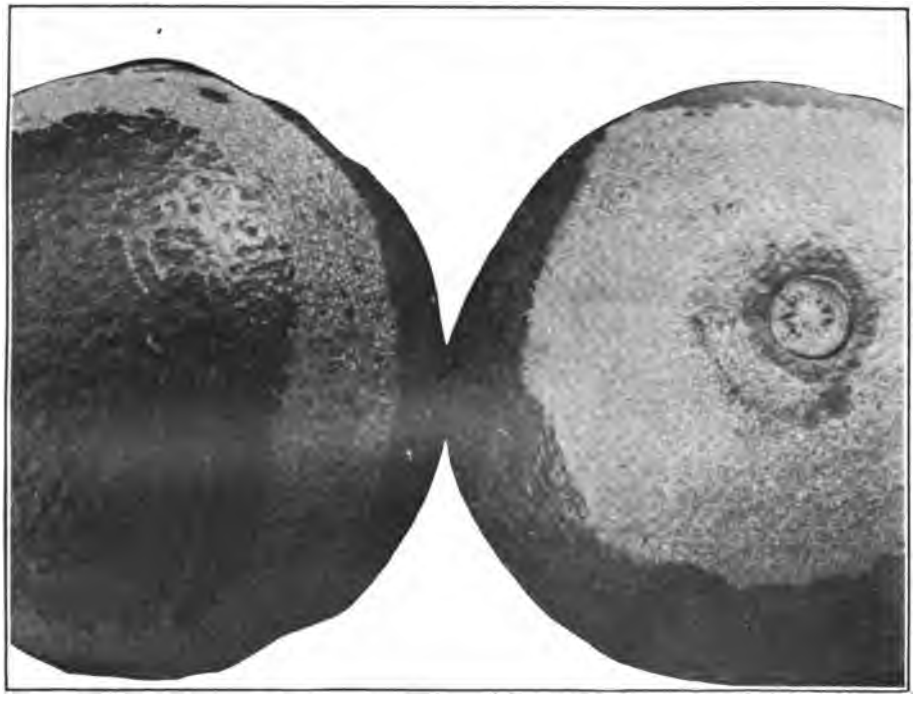

FIG. 2.—Mature oranges, showing injury by citrus thrips. (Original.)

"Fancy," and "Choice"; or "Extra Choice," "Choice," and "Standard." Whatever the terms used there is usually little difference in the quality of fruit of corresponding grades at the different packing houses. In other cases only two divisions are made, the first grade generally being designated as "Orchard Run" and the second or lower grade as "Standard." Under the latter system the quality of the fruit composing the first grade is about the same as would be obtained by placing together all the fruit of the first and second grades of the three-grade pack. Statistics upon the quantity of fruit shipped from the entire San Joaquin Valley and the prices received for it are not available, but from Lindsay and its tributaries 1,525 carloads of navel

oranges were shipped in 1911. The approximate average number of boxes of fruit to the car is 390, making 594,750 boxes for the season's shipment. From examination of thousands of oranges in the field, throughout the district and in many groves, it was calculated that 34 per cent of all the fruit would be classed as first grade so far as thrips injury was concerned, 43 per cent as second grade, and 23 per cent as third grade. Returns received by different packing houses on a total of 358,000 boxes of navels of all grades for the season indicated the following average differences in price per box between the different grades. First-grade fruit averaged 37 cents more per box than that of second grade; the latter 28 cents more than that of third. Fruit shipped in only two grades gave an average difference of 51 cents per box in favor of the first grade. It may be seen from the foregoing data that 43 per cent, or 255,742 boxes, of the Lindsay fruit was reduced to second grade at a loss of 37 cents per box, or $94,624.54; 23 per cent was reduced to third grade at a loss of 65 cents per box, or an additional $88,914.80. There was thus a total loss for the Lindsay district alone of approximately $183,539.34 in the season of 1911 from grade reduction caused by thrips.

SUMMARY OF SEASONAL HISTORY.

In seasons such as 1911, adult citrus thrips first appear in April and increase rapidly during April and May, during which time the insects are congregated largely on the fruit and foliage of the orange. During part of June, July, and August the adults leave the toughening fruit and leaves of the orange and disperse over miscellaneous food plants, and it is during this period of wider separation that mating and oviposition are somewhat checked. In August and September there is a series of flights back to the late summer growths of the orange, where the insects concentrate in large numbers, mating and actively depositing the eggs which produce the insects of the following spring.

The citrus thrips begins to disappear about the middle of October, and after December practically none can be found. There are generally a few larvæ and adults in places on the trees until the early part of January, at which time they disappear completely. The eggs which are deposited in the stems and leaves of the orange in the fall mostly pass the winter successfully, hatching during the ensuing March, April, and May. The seasonal activities of the citrus thrips, as related to orange blossoming, growth periods, and spraying are summarized graphically in figure 3.

SUMMARY OF LIFE HISTORY.

There is a tendency on the part of the citrus thrips to breed throughout the year. All stages of the insect are found on the trees throughout November and December. Larvæ, pupæ, and adults gradually

die off as the weather grows colder, until by the middle of January all have disappeared. The winter is passed only in the egg stage. Eggs deposited in the leaves and stems, mostly during late August, September, and October, hatch and the larvæ appear in March, April, and May.

The average duration of the egg stage of summer generations varies from 10 to 18.8 days during May and June, 6.8 to 8.5 days in July and August, and 17 to 18.8 days in September and October.

The average larval stage varies from 6.6 to 13.7 days during April and May, 4.2 to 9 days from June to August, and 6.7 to 11.2 days in September and October.

The average pupal stage varies from 4.7 to 13 days during April and May, 2.8 to 5.1 days from June to August, and 5 to 19.9 days from September to November.

Pupation takes place in crevices on the tree trunk, in dead leaves and rubbish under the trees, and under clods and particles of trash

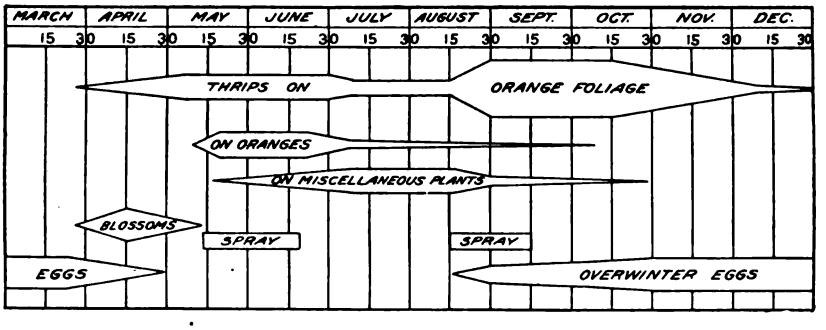

FIG. 3.—Graphic illustration of the seasonal activities of the citrus thrips as related to blossoming and later growth periods of the orange, and indicating also the spray periods. (Original.)

on the ground, but never in the ground. The pupa is naked, does not construct a cell, and is at all times capable of locomotion.

The average duration of adult life is from 25 to 35 days, with extreme instances running to from 46 to 49 days. Adults can live from 2 to 6 days only without food.

The number of generations in a season will depend upon the character of the season. An early, warm spring followed by a prolonged, hot summer may result in the production of eight or more generations. In seasons such as 1911, six full generations may be expected between the middle of April and the first of November. For purposes of control the citrus thrips must be treated as an insect having only a single generation a season, and with an egg-laying period extending from April to November.

REMEDIES FOR THE CITRUS THRIPS.

Certain measures against the citrus thrips have been persistently recommended in spite of abundant evidence of their inapplicability. These are usually directed against the pupal stage and consist in the application of insecticides to the soil, breaking the soil up fine to destroy the insects supposedly pupating there, and burning dead leaves and trash, which accumulate under the trees, to destroy the pupæ. These methods are worthless for the reason that the thrips

FIG. 4.—Resin-wash injury to half-grown oranges sprayed for the citrus thrips. (Original.)

do not go into the soil at all, and only a varying and often small percentage of them pupate in the trash. Fumigation with hydrocyanic-acid gas will reach and kill only the larvæ and a small number of adults, and is accordingly too expensive to use. Distillate-oil emulsions and proprietary emulsions containing distillate, even when used as weak as 2 per cent, stain the ripe oranges, and are otherwise so injurious that it is considered unsafe to use them. Commercial lime-sulphur is not noticeably injurious when used at less than 1 part to 28 parts of water. Resin wash can not be safely used on orange trees at any strength. Where the resin mixture comes into contact with the fruit the epidermal cells are killed and

a shallow brown scab is formed. (Fig. 4.) Where the liquid collects in large drops it forms a thick, amber-to-black scab which does not slough off readily. About 20 per cent of the fruit at picking time was thrown into the lowest grade owing to scabbing through the use of the weakest resin wash.

There is only one cheap and effective method of citrus-thrips control, viz, the application at high pressure of contact insecticides, preferably mixtures containing sulphur in solution. Sulphur mixtures at the proper strength have given uniformly high killing results and have thus left no doubt as to their insecticidal power over this species. They further show a more or less marked tendency to repel the insects and prevent rapid reinfestation of sprayed trees.

SPRAY MIXTURES AND DILUTIONS.

Of the large number of combinations of insecticides tested, the following have given the best results, and any of the mixtures here recommended may be relied upon to do good work:

1. *Commercial lime-sulphur.*—If the lime-sulphur is of a density of 36 degrees on the Baumé scale, dilute 1 gallon with 56 gallons of water; if of a density of 33 degrees Baumé, dilute 1 gallon with 50 gallons of water.

2. *Sulphur-soda solution.*—Two gallons of the stock solution, prepared as described on page 8, diluted with 25 gallons of water.

3. *Commercial lime-sulphur and blackleaf tobacco extract (40 per cent nicotine sulphate).*—Dilute 1 part of the commercial lime-sulphur, if 34 to 36 degrees Baumé, with 86 parts of water; if 30 to 33 degrees Baumé, with 75 parts of water. Then add 1 part of the tobacco extract to 1,000 parts of the lime-sulphur diluted as above.

4. *Blackleaf tobacco extract (40 per cent nicotine sulphate).*—Dilute 1 part with 800 parts of water.

COMMERCIAL LIME-SULPHUR.

The commercial lime-sulphur, diluted with water and without the addition of other chemicals, is preferred to any of the other insecticides because of its cheapness and convenience in mixing. Very good grades of lime-sulphur can be purchased in the market at a reasonable price, and since the preparation of this product requires care and experience, and as it must be made fresh each time or special precautions taken to store it in air-tight containers, its home manufacture is not advised. When necessary to carry the market product over a season it is essential to protect it absolutely from the air, as it rapidly loses its insecticidal power when exposed through leaky barrels or an open bung.

SULPHUR-SODA SOLUTION.

Another mixture containing sulphur as the most important ingredient is made by dissolving sulphur with the aid of caustic soda, according to the directions given below. This mixture, though

practically as effective in controlling the citrus thrips as lime-sulphur, can not be purchased ready-made and is therefore less convenient to handle. Furthermore, at the present writing it costs just as much per dilute gallon as the factory-made lime-sulphur.

The sulphur-soda stock solution is prepared as follows:

Powdered sulphur	30 pounds.
Powdered caustic soda (98 per cent)	15 pounds.
Water to make	30 gallons.

The sulphur is made into a paste with water, and while the mixture is being constantly stirred the soda is added in sufficient quantity to start boiling. As boiling becomes violent a little water is added to retard it. When the sulphur has all been taken into solution enough water should be added to bring the stock solution up to 30 gallons. If made according to the foregoing directions the final product will be a clear, amber-colored liquid much resembling good commercial lime-sulphur.

PLAIN TOBACCO EXTRACTS.

Tests with plain tobacco extracts without the addition of lime-sulphur or other preparations have given very good results when the tobacco has been used at sufficient strength. Tobacco extract containing 40 per cent nicotine used at the rate of 1 part to 800 parts, liquid measure, of water is quite satisfactory; when diluted at the rate of 1 part to 1,600 parts water, however, its efficiency is noticeably lowered. It can not be recommended for this work in solution weaker than 1 to 1,000, and should preferably be used at the rate of 1 to 800. The commercial tobacco extract containing a high percentage of nicotine sulphate is very convenient to handle and costs approximately $0.016 for each gallon of the diluted spray, when used at the rate of 1 part to 800 parts of water.

TIME AND NUMBER OF SPRAY APPLICATIONS.

Unfortunately no specific dates, which will hold for every season, can be fixed for the applications of the spray. The investigations of the seasons of 1910 and 1911 have shown that the date on which the thrips first become numerous and injurious and the navel-orange blossoms lose their petals varies as much as 30 days in certain seasons, due to the nature of the spring weather, and, further, that it varies in different orchards in the same season. The greatest injury to the fruit is done between the time the petals fall and the fruit is half grown. It has been demonstrated that three applications of the insecticide are necessary during this period to prevent marking of the fruit. The first spring growth has usually hardened by the time

the petals have all fallen, and the thrips then seek the young fruit. The petals do not all fall at once, but come down gradually, and the transfer of thrips is therefore gradual.

The first application should be made as soon as four-fifths or more of the petals have fallen. This checks the insect at a time when the orange is most susceptible of deep injury and when the blossoms have passed the period at which pollination might be interfered with by the spray.

After the first application more larvæ will issue from eggs deposited in the very young fruit, and additional adults will appear from the specimens pupating at the time of the application. The second application must therefore be timed to prevent this renewed attack, which may be expected to reach the danger point in from 10 to 14 days after the first spraying. This second spraying should not be too long delayed, as a comparatively few larvæ may, by their persistent habit of feeding in a circle about the base of the fruit, cause considerable injury. Special effort should be made to drench all the fruit as well as the few remaining tender leaves thoroughly, as it is here only that the insects occur.

The third application may be longer delayed if the first two have been thorough and well timed. It generally takes the insects from two to three or four weeks to become dangerously numerous again, as they reinfest the sprayed trees very much more slowly after the second application.

After the third application the fruit rapidly loses its attractiveness, and the insects then find it necessary, in order to secure food, to spread out over the few remaining tender orange leaves and certain miscellaneous food plants. During the latter part of August and in early September there is usually another abundant growth of shoots upon which the thrips congregate in great numbers. A fourth application in late August or more probably in September should be timed to catch the insects as soon as they become numerous and before any great amount of leaf injury appears.

The importance of protecting this growth is evident to those familiar with the stunted condition of orange trees in certain orchards of Tulare County as the result of continuous feeding of large numbers of thrips during the first five or six years of growth. The writer has in mind an orchard in which trees five years from the nursery are no larger than the average 2-year-old trees in localities more favorably situated with regard to thrips, and which each year have a very large percentage of the leaves so severely injured that they roll up into tight curls.

SPRAY APPLICATIONS TO NURSERY STOCK.

While definite dates can not be given for the application of sprays to nursery stock, it follows in the case of trees budded in the fall, where the original stock is allowed to put forth a good growth in the spring, that it is sometimes advisable to spray during April, but only when thrips have become quite numerous and for the purpose of ridding the trees of them before the scion has grown sufficiently to attract them. Preferably the stock should be largely cut back as soon as the bud is well under way, and this is generally done in Tulare County before May 1. The prunings should be burned in every case to destroy eggs and larvæ which may be present. The growing scions must then be watched carefully, and as soon as thrips appear in numbers spraying should begin. They should be further watched with the same care throughout the remainder of the growing season and sprayed as often as the abundance of thrips makes them liable to severe injury. Nursery stock will usually require from three to five applications a season, depending largely on the amount of growth it produces. Once the scion has completed its first growth and become distasteful to thrips the next most important growth will usually occur late in July or in August.

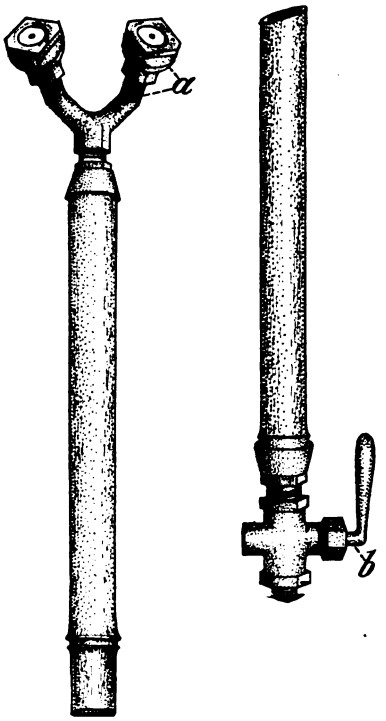

FIG. 5.—Correct spray rod and nozzle connections: *a*, Two nozzles fitted on "Y" branch; *b*, shut-off at base of spray rod. (Original.)

To summarize, the first application should be made when thrips begin to get numerous on the spring growth, usually between April 15 and May 15, after which from two to four further applications will be necessary, according to the conditions of infestation.

SUGGESTIONS ABOUT SPRAYING.

The gasoline-power outfit, by reason of its large nozzle capacity, simplicity, reliability, and comparatively low cost of operation, is the only class of sprayer here recommended for spraying bearing orchards, young orchards in excess of 10 acres, and large nurseries. Hand-power outfits, when of the right type and capable of maintaining a pressure of not less than 125 pounds, are suitable and even preferable

for spraying seed-bed and nursery stock, and they may also be used in young orchards of small acreage.

The spraying outfit should be on hand, set up, and in perfect running condition not later than April 1, and the insecticide materials at hand and conveniently located near the water supply, and as close as possible to the orchard or nursery to be sprayed. It is necessary to order supplies not later than the January or February preceding the spraying operations in order to insure having the material at hand when wanted.

HOW TO SPRAY BEARING ORCHARDS.

It is best to use only two 50-foot leads of hose on a power outfit, with 10-foot rods each fitted with a "Y" (fig. 5) which is angled to handle two nozzles. The latter should be of the large chamber type, with disks bored to one-sixteenth inch, and should throw a double cone of spray which breaks into a fine mist at about 4 feet (fig. 6). The first application should usually be started just before all the petals are down. While the sprayer is being driven between the rows each rodman should begin work at about the middle of his tree on the side away from the sprayer and work around the tree until he meets the starting point; he should then switch to the same point on the next tree without shutting off the nozzles and with as much economy of movement as possible. (See figure 7, which shows easy and correct position for spraying.)

FIG. 6.—Mist spray from twin nozzles. (Original.)

The nozzles should be held about 2 feet from the tree so that the broad portion of the stream plays upon fruit and leaves. The trees should be swept from tip to base, special attention being given to the fruit and the tender growth, where the insects congregate. The pressure, if maintained at 150 pounds or more, will turn the leaves over so that both sides will be sprayed. No

attention need be paid to the inner portions of the tree, as thrips do not occur there.

One should not attempt to spray too many trees with a single outfit, and an application once commenced should be finished within 10 days. It has been found after much experience that only about 25 acres of from 12 to 18 year old trees or 50 acres of from 5 to 7 year old trees can be successfully handled with one gasoline-power sprayer. This is calculated on the basis of ten 200-gallon tanks of spray per day, allowing 8 gallons per tree for trees from 12 to 18 years old or 4 gallons for trees from 5 to 7 years old, allowing 100 trees to the acre. It is a common mistake to use the wash too sparingly and to try to get over the ground too fast. Table I, published also in a former report,[1] was prepared to show approximately the correct amounts to apply to trees of different ages, and from it the quantity of spray material required for the season may be estimated.

FIG. 7.—Correct position of operator in spraying. (Original.)

TABLE I.—*Quantities of liquid required in spraying for the citrus thrips.*

Age of trees.	One application.	
Years.	Gallons dilute spray per tree.	Gallons per acre of 100 trees.
2 to 3...	2	200
5 to 7...	4	400
8 to 10..	5	500
12 to 18.	8	800

[1] Jones, P. R., and Horton, J. R. The Orange Thrips: A Report of Progress for the Years 1909 and 1910. U. S. Dept. Agr., Bur. Ent., Bul. 99, pt. 1, iv+16 p., 2 fig., 3 pl., Mar. 6, 1911. See p. 15.

The spraying must be very thorough, and to be effective the insects must actually be hit by the spray. It will very much improve the results if the rodmen are shown the insect they are to spray for and just where it will be found in greatest numbers. In this way the object of spraying is made definite. By keeping the thrips reduced to a minimum during the period between the dropping of the petals and the time when the fruit is half grown, most of the fruit scarring and the leaf curl of the early summer growths of foliage can be prevented. An application at the proper time in late August or in September will prevent the severe leaf curling which usually occurs to all late summer growths.

HOW TO SPRAY NURSERIES AND YOUNG TREES.

For large nurseries, where the gas-engine outfit can be advantageously used, it is preferable to the hand outfit. Two 25-foot or even 15-foot leads of hose and 12-foot spray rods are generally most convenient for this work. However, when an outfit has already been fitted with 50-foot hose and 10-foot rods, with the intention of spraying older trees as well as nursery stock, this equipment may be made to serve very well for the latter. In such case the excess hose length should be coiled over a peg or bracket fastened to the spray tank or engine hood, so that the young trees will not be injured by the dragging hose. It is preferable in setting out a nursery to leave driveways wide enough to accommodate a sprayer and team at intervals throughout the length of the bed. Where it is desired to have the nursery rows 4 feet apart, which is the usual practice, it is convenient to have wagon room between the fourth and fifth rows from one side, and again between the 12th and 13th, 20th and 21st, etc. With this arrangement eight rows of trees, four either side of the driveway, may be reached each trip, using 12-foot spray rods; eight more rows may be taken on the return trip, etc.

The large chamber-type or single Bordeaux nozzles may be used to good advantage, but the rapidity of delivery of the spray need not be so great as that necessary for orchard work. It is better to progress more slowly, covering all portions of the little trees, without undue waste of liquid. The trees will need attention only when the growth is tender.

COST OF SPRAYING AS COMPARED WITH RETURNS.[1]

Thrips injury to citrus fruits is confined to the rind and does not appreciably affect the eating quality of the fruit. Except in seasons of unusually gross infestation no great amount of fruit is lost entirely by reason of thrips injury. The argument has been advanced that where the fruit is separated into but two commercial grades, which embrace everything fit to ship, as is now largely the case, thrips injury will have but little effect on the price. The damage thrips do to the trees by interfering with the functions of the leaves throughout the early years of growth, however, is generally overlooked. The following statement takes no account of this indirect injury to the trees, which is difficult to estimate, but merely gives the profit realized from producing a better grade of fruit by spraying.

Cost of spraying one acre of 18-year-old navel orange trees.

Labor:	
2 rodmen at $2.50 each per day, cost per acre	$1.22
Driver and team at $5 per day, cost per acre	1.23
Cost of labor per acre, one application	2.45
Insecticide:	
14 gallons lime-sulphur at 14 cents, cost per acre, one application	1.96
Fuel, oil, and miscellaneous:	
Gasoline, 1½ gallons at 25 cents, per acre, 3 applications	.625
Oil at $1 per gallon, per acre, 3 applications	.025
Repairs and batteries, per acre, 3 applications	.21
Estimated cost of fuel, oil, etc., per acre, 3 applications	.86
Cost of labor per acre, 3 applications	7.35
Cost of insecticide per acre, 3 applications	5.88
Cost of fuel and miscellaneous per acre, 3 applications	.86
Total cost of treating 1 acre of 18-year-old navel orange trees	14.09

Returns from sale of fruit.

Number of packed boxes fruit produced per acre	324
Per cent of fruit raised from second grade to first grade by spraying	18
Boxes raised from second grade to first grade by spraying	58
Difference in price received per box for first-grade over second-grade fruit	$0.51
Amount saved per acre by spraying	$29.58

Profit from sale of fruit.

Amount saved per acre by spraying	$29.58
Cost of spraying per acre	14.09
Clear gain per acre from the treatment	15.49

[1] The figures given upon cost of spraying are based on the Bureau of Entomology's own spraying work in the season of 1911. The number of boxes of fruit given, 324 per acre, was the actual production of the portion of grove under experiment, and as these trees were not at their best and since 18-year-old trees usually produce more than 324 boxes per acre, the saving effected by spraying would tend to be greater in most cases. The difference of $0.51 per box between first and second grade fruit was that which was actually shown by packing-house returns, and practically all the grade reduction was caused by thrips alone.

In the above calculation the cost of spraying an acre of 18-year-old trees is higher than will usually be the case, since, as a rule, the grower is obliged to have a team on hand all the time and may therefore reduce the item of team hire; he may also be able to reduce the cost of labor somewhat in many cases. In seasons of gross infestation, and in certain orchards every season, the returns will be greatly increased over the figures given because of the excessive infestation in such seasons and orchards.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

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Contribution from the Bureau of Entomology, L. O. Howard, Chief.

THE ROUNDHEADED APPLE-TREE BORER.[1]

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INTRODUCTION.

Several species of insects occur in the United States that in their larval or grub stage injure apple trees by boring into the bark and wood. The most destructive of these, in the eastern half of the country, is the roundheaded apple-tree borer. The borers of this species hatch from eggs deposited by a rather large beetle in or under the bark of the trees, usually near to the ground, and feed to such an extent on the inner bark and wood that the trees are greatly weakened and often die as a direct result of the injury. Trees of all sizes are attacked, but those from 3 to 10 years old suffer most. As the borers feed they throw out, through small holes which they make in the bark, sawdustlike castings of a reddish color. (Fig. 11.) Heaps of these castings found at the base of apple, pear, or quince trees are

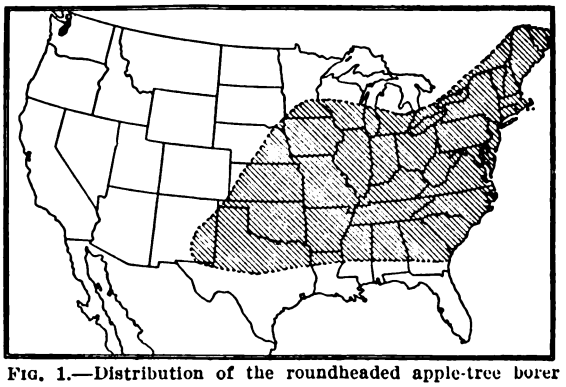

FIG. 1.—Distribution of the roundheaded apple-tree borer (*Saperda candida*). (Original.)

NOTE.—This bulletin describes an insect which in the larval or grub stage is most destructive to apple orchards in the eastern half of the United States. (See fig. 1.) Methods for its control are given.

[1] *Saperda candida* Fab.; order Coleoptera, family Cerambycidæ.

always an evidence that the trees need immediate attention. Frequently an examination of an orchard induced by finding one tree with castings at the base will reveal the fact that many trees are affected and that serious injury has already been done.

In many localities the borers of this species are so abundant that when young apple orchards are neglected practically all the trees will be killed or injured beyond recovery before they are 10 years old. (Fig. 2.)

HISTORY AND DISTRIBUTION.

The roundheaded apple-tree borer is a native of North America, and has been known in this country as an enemy of cultivated fruit trees for nearly a century. Before orchards were planted here it doubtless bred in the wild trees, which it still inhabits.

FIG. 2.—Young apple tree dying from injuries caused by roundheaded apple-tree borers. (Original.)

The species was first described by Fabricius in the year 1787. It was redescribed by Thomas Say in 1824, the description containing a note that the insect injured apple trees by boring in the wood. In 1825 it was observed to be attacking fruit trees about Albany, N. Y., and during the same year was reported to have caused a loss estimated at $2,000 in one orchard at Troy, N. Y. Since that time there have been frequent complaints of great injury over a wide scope of country in the eastern half of the United States and southeastern Canada. Instances of the entire destruction of apple and quince orchards by this insect are not uncommon, and the cost and trouble of protecting trees against its ravages amount to an important item in the expense of orchard maintenance throughout the region where the species occurs. Its known range may be bounded by a line extending from near the mouth of the St. Lawrence River westward through Quebec and Ontario to Minnesota, thence through Nebraska, Kansas, New Mexico, Texas, Louisiana, Mississippi, Alabama, and Georgia to the Atlantic coast. (See fig. 1.) Curiously

enough, this line, except in its southwestern extent, bounds also rather definitely the distribution in America of the service tree,[1] which is one of the borer's favorite host trees.

Throughout the range of this insect there are many restricted localities where it does not occur, or, at least, is so rare as to have escaped notice. It is not uncommon to find the borers exceedingly abundant in one orchard while in other orchards, perhaps not more than a mile away, it may never have appeared in sufficient numbers to have attracted attention. This tendency of the species to be present in one locality and absent in an adjoining one is an interesting phase of its distribution. It has been noticed that where soil conditions and other causes favor an abundant growth of wild trees in which the borers breed, near-by cultivated trees will suffer more than where such natural breeding places are not present.

As a rule the parent female beetle in ovipositing does not move far from the tree in which she was developed, providing there are suitable trees near by in which she can place her eggs. (Fig. 3.) This tendency of the female to spend her adult life and provide for her progeny within a restricted area accounts very largely for the irregularity in the local occurrence of the borers. An adult female issuing in an orchard is quite likely to deposit all her eggs within a few rods of her host tree; thus it is that in infested orchards that have not been entirely neglected in respect to this pest the borers are likely to be found infesting groups of half a dozen or more trees standing close together. It is a common observation, especially in newly planted orchards, that the trees standing near to woods in which service, wild crab, or mountain ash trees grow, or those adjacent to old infested orchards, are the ones to be first attacked by the borers. This is so because the woods and neglected orchards are breeding places for the borers, and when the adult insects appear they select the near-by orchard trees for attack. This is an important point to keep in mind in the work of ridding orchards of, and keeping them free from this pest.

FOOD PLANTS.

This borer, so far as is known, confines its attacks to a few species of trees belonging to the family Rosaceæ. Even among the limited number of its host plants the insect shows considerable discrimination, greatly preferring as food some species of trees above others. Of our cultivated fruits, quince, apple, and pear suffer about in the order named. Service (figs. 18, 19), wild crab, mountain ash, thorns of different species, and chokeberry are the wild or native trees which serve as its food. These wild trees are named, also, about in

[1] *Amelanchier canadensis.*

the order for which preference is shown, service, crab, and mountain ash being more often attacked than the others.

The relation of native host trees to the local distribution of the borers is important. Frequently a clump of these trees growing in a neglected field or those growing in the woods will be infested

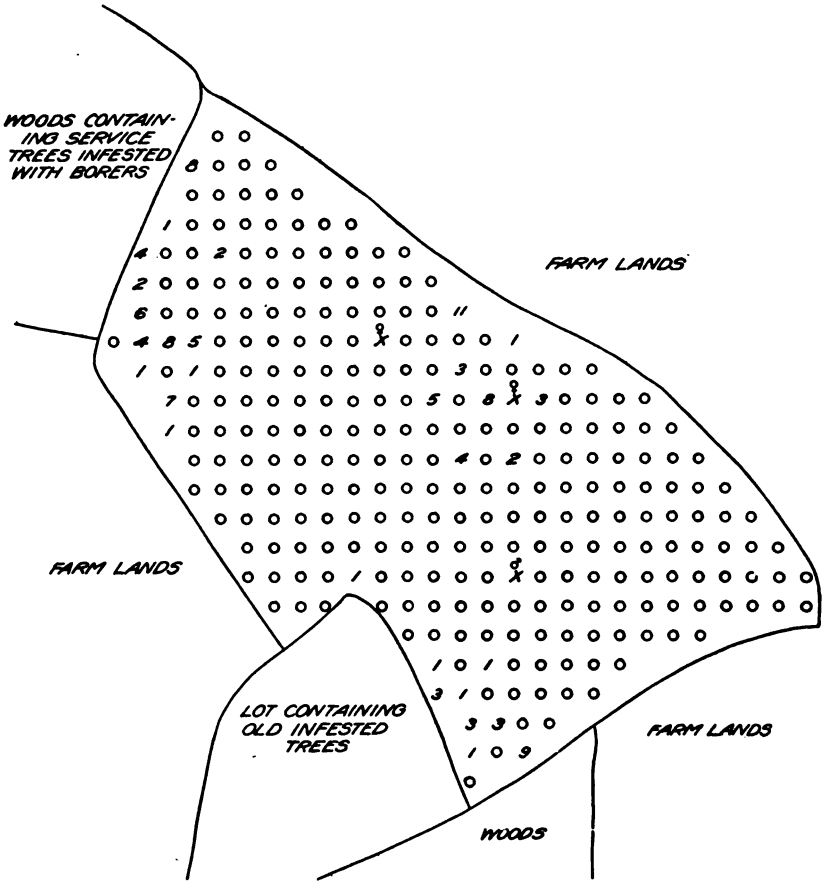

FIG. 3.—Diagram of orchard illustrating the tendency of the adult female roundheaded apple-tree borers to group their eggs about the places where they develop. o, o Represent trees; × represents trees from which male and female beetles issued in 1914; figures represent number and position in the orchard of eggs deposited in 1914. Note how eggs are grouped about the two orchard trees from which females issued, the lot containing old infested apple trees and the woods in which the borers breed in service trees. (Original.)

and will year after year be a source, and possibly the principal source, from which adult insects are produced to fly out and deposit eggs in adjacent orchards.

In exceptional cases peach, cherry, and plum trees are said to be attacked by this species, but this occurs very rarely, the common peach borer being the larval form of an entirely different insect.

LIFE HISTORY.

To pass through the four forms or stages of its life cycle this insect requires in some cases two years and in others three years. In the central part of West Virginia about two-thirds of the individuals reach the adult stage the second season after hatching, while the other third do not become adult until the third season from the egg. It is quite probable that throughout its northern range most or all of the individuals require three years to complete the life cycle, while farther to the south, where the annual period of feeding is longer, all the borers may pass through the same transformation in two years.

THE EGG AND OVIPOSITION.

The adult borers issue from the trees during late spring and early summer, the emergence of the brood occupying a period in any given locality of from 15 to 20 days. Between the southern and northern limits of the species' range the calendar dates of the beginning and ending of the emergence of adults probably vary about two months.

FIG. 4.—Egg punctures of roundheaded apple-tree borer in apple bark. Three punctures are to be seen. Natural size. (Original.)

The beetles occasionally fly by night, but are less nocturnal in their habits than was formerly supposed. Emergence from the trees takes place by day, as does the laying of most, and probably all, of the eggs. The males appear two or three days in advance of the females and usually die first. In a week or 10 days after the females issue egg laying begins and is continued for 40 or 50 days, a single female depositing normally from 15 to 30 eggs. In preparing a place for the egg the female makes use of her jaws to cut a short, curved incision in the bark (fig. 4); then with her strong, extensile ovipositor she forces a side opening from the bottom of the incision (fig. 5), at the end of which a single egg is placed. During the period of oviposition a female may pass several days without depositing eggs and may then lay from 1 to 5 within an hour. Usually at least 2 or 3 eggs are laid at a time, the operations attending the laying of each following close together. The several eggs are as a rule placed in one tree. This explains the fact, which has often been noticed,

that where one borer is found others are quite likely to be in the same tree.

The eggs are inserted through the opening in the bark and are placed from one-fourth to one-third of an inch to one side of the entrance. In young trees they are deposited between the bark and wood (fig. 6), but in old, thick-barked trees they may be placed between the layers of bark.

The yellowish or rust-brown egg (fig. 6) is slightly more than one-eighth of an inch long by one twenty-fifth of an inch wide at the middle, both ends tapering to the rounded points. The shell is tough and plastic, allowing the egg to shape itself more or less to the space which it occupies in the tree. The eggs hatch in from 15 to 20 days. As a rule they are placed in the tree just above the surface of the ground. Where the female can find a crack or opening between the soil and the base of the tree large enough to enter, she may place eggs an inch or so below the surface of the ground (figs. 7, 8). Rarely the eggs are deposited higher in the tree about a crotch or an uneven place on the trunk. In the latitude of West Virginia and Maryland egg laying is in progress from the last of May until the middle of July, the period being somewhat later in the season than the dates given at the higher elevations of the mountain districts.

FIG. 5.—Adult female of the roundheaded apple-tree borer in the act of depositing an egg. Slightly enlarged. (Original.)

THE LARVA.

The larva, or borer (figs. 9, 10), is a whitish, footless grub, with brown head and black jaws. It attains a length when full grown of nearly an inch and a half. On hatching, the young borers attack the inner bark, where they continue to feed until late in the season; whereupon some of them, especially in young trees with thin bark,

gnaw their way into the sapwood. During the first season the young borers feed and grow rapidly, and where several occur in one tree they may completely girdle and kill it before winter. Their burrows at this time are in the form of broad, irregular, usually more or less circular galleries beneath the outer bark, near to the point where the egg was laid. The borers avoid one another in the tree, and the forms of their galleries are often affected thereby, being made narrower and more elongate to avoid contact. This habit increases the liability of their being overlooked by orchardists who practice the digging-out, or "worming," method.

FIG. 6.—Inner surface of bark peeled from young apple tree showing position of eggs of roundheaded apple-tree borer. Natural size. (Original.)

As the borers feed they keep an open space in the burrows about themselves, thrusting their castings into abandoned corners or out through small holes made by them in the bark. These castings form little heaps of reddish, stringy wood fragments around the base of the tree (fig. 11) and afford one of the sure marks by which infested trees may be detected.

FIG. 7.—Female beetle splitting the bark of a young apple tree just below the surface of the ground preparatory to depositing an egg. (Original.)

The borers spend their first winter in the burrows near the ground and resume feeding early the following spring, attacking now the solid wood almost exclusively, and, in young trees, penetrating to the heart. During the summer those that are to attain the adult stage the following year begin to extend their burrows up the trunk a half

inch or more beneath the bark. As previously stated, part of the borers do not become adult until they are 3 years old; these remain feeding in the wood near the ground until the third summer, when they, too, work their way up the trunk in the manner just described. The winter previous to pupation is passed by the borers in the pupal cell or chamber (fig. 12). This chamber is a space at the upper end of the gallery which curves out to the inner bark above and contains in the curved portion next to the bark a small quantity of fine, sawdust-like particles of wood. The chamber is 2 or 3 inches in length, being limited at the lower end by a packing of coarse, string-like wood fiber. In the spring the point at which the chamber extends to the inner bark begins to show from the outside as a slightly depressed, dead spot in the bark. This spot marks the place from which the adult is to issue later, and is especially noticeable on young, smooth-barked trees.

FIG. 8.—Female beetle placing an egg in the tree below the surface of the ground. (Original.)

THE PUPA.

The pupa (fig. 13) is an intermediate form between the larva, or borer, and the beetle which deposits the eggs. In this form the insect is of about the same color as the borer, but the shape is greatly changed, the legs, wings, antennæ, and other appendages which the adult is to possess being now visible. The insect does not feed while in this stage and is incapable of motion except that of wriggling about in the chamber. It occupies a vertical position in the tree with its head up. The change from the borer to the pupa takes place at the time apple trees are in bloom, the pupal stage covering a period of about three weeks.

THE ADULT.

The borer attains the adult stage 10 days or 2 weeks before it leaves the pupal chamber. When ready to issue it gnaws a circular hole through the bark (fig. 14) and escapes.

The beetles average about three-fourths of an inch in length, exclusive of the antennæ. The color is light brown above with

FIG. 9.—Roundheaded apple-tree borer. First summer in tree. Natural size. (Original.)

FIG. 10.—Roundheaded apple-tree borer. Second summer in tree. Natural size. (Original.)

two broad, white bands, joined in front, extending the full length of the back; the underparts and front of the head are white. The female is larger than the male, the body being thicker and heavier. (Fig. 15.)

All the beetles in a given locality issue from the trees within a period of two or three weeks. After they emerge they seek the branches of the trees, where they spend the greater part of their lives

resting among the foliage. The females make short flights in search of trees in which to oviposit. Rarely they fly for a considerable distance, but where suitable trees in which to deposit eggs are abundant they usually pass their lives within a few rods of the trees from which they issue. (Fig. 3.) The males in seeking their mates make longer and more frequent flights. Both sexes are active by day and at twilight in warm weather, and, although they occasionally fly at night,

FIG. 11.—Castings of roundheaded apple-tree borers at base of young apple tree. (Original.)

the hours of darkness are more likely to be spent in quiet among the branches.

The adults do considerable feeding on the bark of twigs and on the midribs and stems of leaves (fig. 16), and they also show a fondness for the moisture that is contained in castings thrown from trees by borers still in their larval stage. This habit is not important from the standpoint of any noticeable injury which such feeding does to the tree, but it causes the death of some of the beetles when they

feed from trees that have been sprayed with arsenical poisons and suggests spraying with arsenicals as a possible means of combating the borers.

When ready to oviposit the female usually crawls down the trunk of the tree to the ground and slits the bark with her mandibles (figs. 4, 7), after which she turns around, inserts her ovipositor into the slit (fig. 5) and deposits an egg, the whole operation occupying about 10 minutes. She may deposit as many as 5 eggs without resting and will then crawl back up the trunk or move away a short distance over the ground and fly to the branches above or to a neighboring tree.

The average life of a beetle is about 40 or 50 days, although individuals occasionally live to be 70 or 75 days of age.

FIG. 12.—Roundheaded apple-tree borers in pupal chambers. Position occupied during winter previous to emergence as adults. (Original.)

NATURAL ENEMIES.

All observers agree that woodpeckers destroy great numbers of the borers by drilling into the trees and removing them from their burrows. The marks made by these birds in searching for borers may be found in the trunks of trees in almost any infested orchard. In some cases from 50 to 75 per cent of the borers are destroyed in this way. Most of the borers devoured are taken from the pupal chamber or while they are making the ascent of the trunk preparatory to pupation. It is rather unfortunate that the birds so often wait until the borers have done the principal part of their injury to the tree before they remove them. Probably both the hairy and downy woodpeckers feed on the borers.

One hymenopterous parasite, *Cenocoelius populator* Say, has been reported from Indiana, but in many localities this species is doing very little in the way of holding the borers in check.

METHODS OF CONTROL.

This insect in its borer stage lives and feeds under the bark where no poisonous or contact sprays or washes can be directed against either its food or its body, and consequently it has always been considered a difficult pest to control. Modern insecticides have not been used so successfully against it as against many other common insect

FIG. 13.—Pupæ of roundheaded apple-tree borer. (Original.)

enemies of the orchard. However, there are practicable methods whereby the borers may be destroyed, or oviposition prevented, and injury thus greatly reduced or entirely eliminated, even in orchards that have suffered severely. In the use of these methods timeliness and thoroughness are essential factors, just as they are essential in the processes of combating most insect pests.

WORMING.

Removing the borers from trees by the use of a knife and piece of wire, a practice commonly known as worming, is one of the oldest and, when thoroughly done, one of the most effective ways of dealing with this insect. In worming trees the operator should be equipped with a strong pocketknife, a piece of small wire, a vial of carbon bisulphid, a small quantity of cotton batting, and a garden trowel. (Fig. 17.) These articles may be carried very conveniently from tree to tree in a small basket. The knife should have a long, sharp blade and the wire should be bent to form a small hook at one end and a circle or ring at the other. Into the ring a scrap of white or brightly colored cloth should be tied as a safeguard against losing the wire. The trowel is for use in scraping away from the base of the tree any earth or litter that interferes with a close search for castings of the borers. When castings are found the bark should be cut away sufficiently to allow the borer to be traced by its burrows and killed. If the cutting is done with care, and the borer secured, the wound will usually heal without noticeable injury to the tree. The natural healing tendency of the tree may be assisted by covering the wound with lead paint.

FIG. 14.—Adult roundheaded apple-tree borer just emerged from exit hole in bark. Natural size. (Original.)

During the first few months of its life the borer is easily found and destroyed, but after it has been feeding a year or more the difficulty of locating it is increased, since at that time its burrows extend more deeply into the tree. However, with a little practice one becomes rather adept at securing the borer regardless of its age or the position it may occupy in the wood.

As the borers engage in burrowing in the tree they keep a clear space behind them, and up to the time the pupal cell is being constructed there is usually nothing to prevent inserting the wire into the exposed end of the burrow and hooking them out. While the

pupal cell is being formed, the burrow below, which up to that time has been kept open, is packed for several inches with wood fiber so that the wire can no longer be used successfully. In all cases where curves or other obstructions in the burrows interfere with hooking the borer out, a little cotton batting dipped in carbon bisulphid should be inserted into the hole and the opening plugged with moist earth. The gas coming from the carbon bisulphid will penetrate all parts of the burrow and will kill the borer. It should be borne in mind that the gas is highly inflammable and that fire should be kept away.

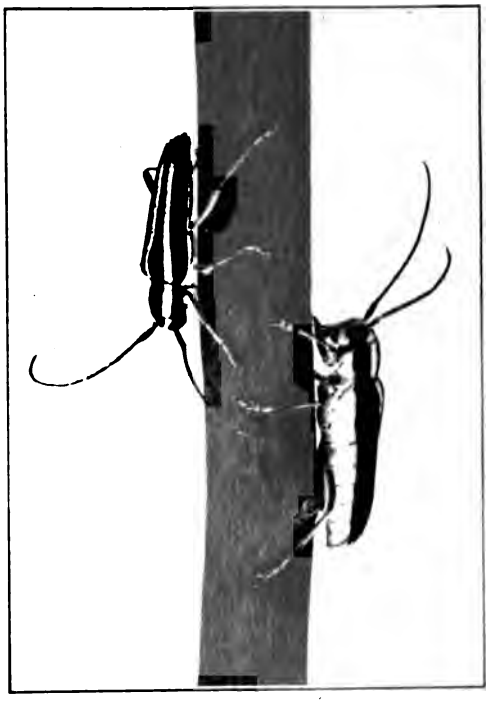

FIG. 15.—Adult male and female roundheaded apple-tree borer. Male on left, female on right. Slightly enlarged. (Original.)

In extensive orchards where worming is done on a large scale by promiscuous labor some of the helpers are likely to become careless and overlook or neglect to destroy an occasional borer. Every female so overlooked stands a good chance of maturing within a year or two, when it will deposit eggs in a half dozen or more near-by trees, causing thereby a continued and an increased infestation in that particular part of the orchard.

The importance of the following points should be kept in mind by all persons who practice this method of borer control:

1. Borers should be removed from the trees as soon as possible after hatching.

2. Every borer in the orchard should be found and destroyed.

3. Borers should not be allowed to breed in cultivated or wild host trees growing within at least 200 or 300 feet of the orchard.

It is the practice with many orchardists to put off the fall worming of trees until after winter apples are gathered. Observations have shown that this practice permits the borers, which feed rapidly while young, to remain in the trees too long for safety. Even in so short a time small trees may be girdled and killed and larger trees seriously injured. In the latitude of West Virginia and Maryland the

work should be done not later than the 1st of September; farther south it may be done several weeks or a month earlier, and north of the States mentioned the time will be correspondingly later. A second examination should be given the trees the following spring to secure borers from belated eggs or those that may have been overlooked at the fall worming.

The fact that the adult female does not habitually wander far in depositing her eggs (see fig. 3) is greatly to the advantage of the orchardist who depends on worming to save his trees. When once his

FIG. 16.—Twig and leaf of apple gnawed by adult roundheaded apple-tree borer. (Original.)

orchard and all surrounding host trees are cleared of the borers he is likely thereafter to be troubled very little by new infestations so long as adults are kept from developing within the area. He should continue his examinations of the trees every year, however, to detect in time any fresh outbreaks arising from eggs deposited by adults that may occasionally fly into the orchard from a distance. Where this method is used all worthless trees in which the borers can breed, growing within a few hundred feet of the orchard, should

be removed. This would include service (figs. 18, 19), mountain ash, wild crab, and thorn trees in woods, as well as the cultivated fruit trees.

PAINTS AND WASHES.

Paints and washes of various kinds have frequently been recommended for use on the trunks of trees, both to prevent the beetles from depositing eggs and to kill the borers within the trees. Experience has shown that it is easier by such means to prevent the eggs from being laid than to kill the borers. Some orchardists report success by applying pure kerosene to the bark of affected trees at the places where castings show borers to be at work. The kerosene is supposed to penetrate the burrow to the insect and kill it. Others have found that this treatment does not destroy enough of the borers to make the remedy worth while, and that in addition the kerosene may kill the bark at the point of application. The danger of injury to trees by the use of kerosene or other mineral oil practically prohibits the use of these substances. Milder solutions, applied in the same way, while not so likely to injure the trees, are even less fatal to the borers.

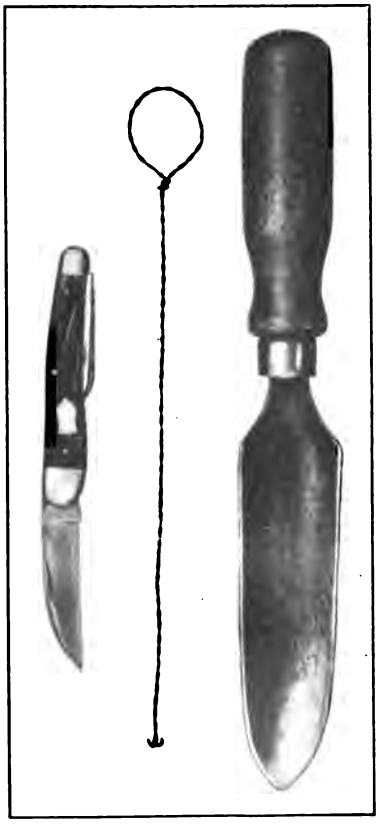

FIG. 17.—Tools for use in removing roundheaded apple-tree borers from burrows. (Original.)

On the other hand, a heavy application, made just before the beginning of the egg-laying season, of some thick paint that will not injure the trees and that will maintain an unbroken coat on the bark for two or three months is very effective in preventing the female from placing her eggs in the bark. The beetle in slitting the bark with her jaws, preparatory to inserting the egg, will very rarely, if ever, make an opening through such a thick coat of paint.

Before applying paint for this purpose the earth around the base of the tree should be removed with a garden trowel or hoe to a depth of 3 or 4 inches. Bark scales and adhering earth should then be scraped from the space to be covered, and the paint applied with a

brush in the form of a band around the tree extending about a foot up the trunk and 2 or 3 inches below the level of the ground. After the paint is dry the earth removed in the beginning should be replaced. The painting may be done more thoroughly and economically by two persons working together on opposite sides of the tree.

The deterrent effect of the paint seems to arise from the mechanical barrier it presents rather than from malodorous or distasteful proper-

FIG. 18.—Clump of service bushes showing exit holes of roundheaded apple-tree borers. (Original.)

ties. The paint should cover the treated portion of the tree in a thick, solid coat, with no cracks or unpainted spaces left, as the beetles will seek out such openings in which to oviposit. Any non-injurious paint that will form a coat of the nature described will answer the purpose. A paint of pure white lead and raw linseed oil, mixed somewhat thicker than for ordinary use, will afford a fair

measure of protection to the tree, providing a heavy coat is applied in a thorough manner just previous to the beginning of the egg-laying season of the borers. The natural growth of the tree will in time cause the paint to crack, but the coat formed by one painting will remain intact and protect the tree during one egg-laying season if applied at the proper time. Better results are likely to be obtained from this treatment on young, smooth-barked trees than on old trees on which the rough bark makes a thorough job of painting more difficult. In the experience of the Bureau of Entomology, apple trees are not injured by the white-lead paint when used as directed. Others have reported injury from supposedly pure white-lead paints, but it is possible that these contained foreign and injurious substances. Those planning to use the raw linseed oil and white-lead paint should insist on receiving this article. There are several so-called tree paints and pruning paints on the market that are valuable for this purpose and appear to be safe for the trees. Annual applications of any of these paints will be necessary.

FIG. 19.—Roundheaded apple-tree borers working in young service tree. (Original.)

Gas tar has been used with some success against peach-tree borers, but should be used with caution on apple trees, as there is serious danger of injury to the bark and wood. Axle grease and paints con-

taining considerable quantities of benzine or turpentine can not be used on apple trees with safety. Some persons have had good success from the use of fish-oil soaps and carbolic-acid washes, but in tests made by the Bureau of Entomology these have not proved to be of any benefit.

MECHANICAL PROTECTORS.

Various mechanical protectors or coverings, to be placed around the lower portion of the trunk for the purpose of excluding the female beetle from the bark, have been devised. Wrappers made of newspapers are quite effective for this purpose. These wrappers, or any protectors of like nature, should be placed around the base of the trunks early in May, the season varying with the locality, and should cover the trunk from a foot or so above the ground to a short distance beneath the surface. The earth at the bottom should be mounded around the protector so as to leave no exposed portion of bark at that point. Building paper, cloth, cotton batting, fine-meshed wire screen, moss, and other materials may be used in the same way with success. Tarred paper has been recommended, but tests have shown that trees wrapped with it are likely to be injured thereby.

Such devices as those just described should be tied at the top close to the body of the tree, preferably with a piece of twine, to prevent the beetles from crawling down to oviposit between the trunk and covering. These protectors have the disadvantage of furnishing breeding and harboring places for the woolly aphis, an insect destructive to apple trees, and for that reason they should be removed from the trees as soon as possible after the egg-laying season of the borer is past. It is probably safe to remove them in any locality by the 1st of September. Eggs will be deposited occasionally around the upper margins of the protectors, but the resultant borers are easily located and destroyed. It is doubtful if trees can be protected as economically with devices of this kind as with paint, and since paint of the proper kind is of almost or quite as much value in preventing attack, it may often be used in preference to the other form of covering.

SPRAYING WITH ARSENICALS TO KILL ADULTS.

As is stated on page 10, the borer in its adult stage feeds more or less on the exposed surface of leaves and twigs (fig. 16) and on the moisture contained in fresh castings thrown out by borers still working in the trees. The quantity of food taken in this way is sufficient to enable the beetles to be killed by spraying with arsenate

of lead trees on which they are feeding. It is doubtful if it would pay ordinarily to spray orchards for the purpose of killing this insect alone, but in exceptional cases, where orchards are badly infested and are not surrounded by prolific breeding places, there is little doubt that the treatment would be profitable. Fortunately the beetles are active at the season of the year when arsenical sprays for the codling moth and other orchard pests are usually applied. These sprays, used primarily to destroy other enemies of the orchard, without doubt kill incidentally many adult roundheaded apple-tree borers.

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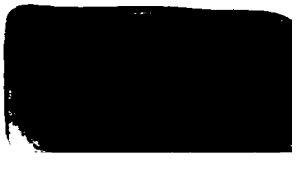

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